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MEMORANDUM

SUBJECT: Drinking Water Assessment for Registration Review of Pymetrozine

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EXECUTIVE SUMMARY

This memorandum provides a drinking water assessment (DWA) to support the registration review of pymetrozine. The DWA was completed using current models and guidance. Parent pymetrozine and six transformation products (CGA 359009, CGA 363431, CGA 363430, CGA 215525, Hydroxy CGA 215525, and CGA 294849) are the residues of concern considered per the Residues of Concern Knowledgebase

Subcommittee (ROCKS) memorandum.[1] All residues are assumed to have similar toxicity to parent, therefore, a total toxic residue (TTR) approach was utilized. Parent-only pymetrozine results are provided for comparison.

All modeled use scenarios were developed based on pymetrozine registered labels and in consultation with the Biological and Economic Analysis Division (BEAD) of the Office of Pesticide Programs (OPP). Estimated drinking water concentrations (EDWCs) for surface water and groundwater for pymetrozine and total toxic pymetrozine residues are provided in **Table 1**. In addition to providing EDWCs for maximum label use rates, EDWCs for use on potatoes (a major use for pymetrozine) based on typical application rates are also included for characterization.

Based on maximum label use rates, TTR EDWCs from sourced surface water are not expected to exceed 47 µg/L as the daily average surface water concentration, 13 µg/L for the 1 in 10 year-annual average, and 10 µg/L for the 30-year annual average in the dietary risk assessment. EDWCs resulting from groundwater from vulnerable wells are not expected to exceed 404 µg/L as the peak groundwater concentration, and 367 µg/L as the post-breakthrough average. The EDWCs decrease by approximately 5X when typical use rates are utilized, and are not expected to exceed 89 µg/L as the peak groundwater concentration, and 79 µg/L as the post-breakthrough average.

EFED recommends that the Health Effects Division (HED) use 404 µg/L as the peak groundwater concentration, and 367 µg/L as the post-breakthrough average in the dietary risk assessment.

[1] U.S. Environmental Protection Agency, Joyce, J, EFED *Data on Pymetrozine and Its Environmental Transformation Products in Support of the ROCKS,* DP D440305, June 1 2017.

Table 1. Estimated Drinking Water Concentrations of Pymetrozine and Total Toxic Residues

Drinking Water Source	Use Site; Modeled Source	Residue	Application Rate	EDWCs from Pesticide Root Zone Model – Variable Volume Water Model (PRZM-VVWM)		
				1-in-10 Year Concentration (µg/L)		30 Year Annual Average Concentration (µg/L)
				Daily Average	Annual Average	
Surface Water	Outdoor – Christmas trees, Ornamentals, & Fruits (Nonbearing fruit and nut trees in nurseries); Index Reservoir	Pymetrozine	Maximum Use Rate[a]	23	5	3
		TTR		47	13	10
				EDWCs from Pesticide Root Zone Model – Groundwater (PRZM-GW) Concentration (µg/L)		
				Peak	**Post-Breakthrough Average**	
Groundwater	Outdoor – Christmas trees, Ornamentals, & Fruits (Nonbearing fruit and nut trees in nurseries); Unconfined well	Pymetrozine	Maximum Use Rate[a]	0.09	NA	
		TTR		404	367	
	Potatoes; Unconfined well	TTR	Typical Use Rate[b]	89	79	

a) Total maximum single use rate from Endeavor and Mainspring Flora product labels: 0.3125 lb a.i./A (0.35 kg/ha) and 5 applications
b) Typical use rate for potatoes: 0.172 lbs a.i./acre (0.193 kg/ha) with 2 applications based on the 90th percentile[2]
NA – Not Applicable due to no breakthrough

Original DWAs were conducted on pymetrozine only, and more recently with pymetrozine plus one degradate of concern: CGA 359009. The current EDWCs discussed in this DWA are higher than those reported in past DWAs, primarily due to the additional residues of concern that were identified from the evaluation of recently submitted environmental fate studies. Additionally, the highest EDWCs resulted from application rates that are higher than those reflected in past DWAs. This assessment also utilizes the most recent aquatic exposure models.

All fate data were evaluated to assess alternative assumptions in the selected input values. In addition, other options for approaching the modeling were evaluated; none of which changed the exposure picture. It is not expected that additional environmental fate studies, such as additional mobility data for degradates of concern, will substantially alter this assessment.

Pymetrozine was detected in a few ambient surface water and groundwater monitoring samples at low concentrations, which may be due to limited sampling. Monitoring data for pymetrozine's transformation products were not available, but were likely not included in sample analysis. The monitoring data is not sufficient to quantify upper bound exposure, and as such, are not recommended for quantitative use in this assessment.

[2] U.S. Environmental Protection Agency, Atwood, D. *BEAD Estimate of Pymetrozine Usage on Agricultural and Non-Agricultural Use Sites*, July 25, 2017.

Use Characterization

Pymetrozine (CAS Number 123312-89-0) is classified as a pyridine azomethine insecticide. This group of insecticides exhibits a unique mode of action characterized as neural inhibition[3,4] of feeding behavior in target pests; particularly aphid species. Pymetrozine works primarily by insect-ingestion but also exhibits on-contact activity. Pymetrozine has residual activity on the plant and will control pests that move onto the plant after spraying.

Pymetrozine is currently registered for non-agricultural and agricultural use sites, and has no aquatic uses**.** Non-agricultural use sites include ornamentals grown outdoors (landscape ornamentals/ground cover, field and/or container grown) and also ornamentals in greenhouses, lath/shadehouses, and interiorscapes. Other non-agricultural use sites include non-bearing fruit and nut trees in nurseries and Christmas trees.

Agricultural use sites include alfalfa, asparagus, cole crops, cotton, cucurbit vegetables, fruiting vegetables, hops, leafy vegetables, pecan, potato, root and tuber vegetables, tobacco, tomato, and vegetables grown for seed (arugula, beet, broccoli raab, brussel sprouts, cabbage, carrot, cauliflower, Chinese cabbage/kale/mustard, collard greens, endive, kale, kohlrabi, lettuce, mustard, parsley, parsnip, radish (other than daikon), rape, rutabaga, spinach, spinach mustard, Swiss chard, turnip (WA); root vegetables grown for seed (OR); tomatoes grown for transplant (FL); and for enhanced management of whiteflies in tomatoes (FL).

A series of national maps highlighting pymetrozine usage data from the United States Geological Survey (USGS) for the years 2011 to 2014 are presented in **Figure 1**. Major use states include California, Washington, Georgia, Florida, and within the grouping of Wyoming, Colorado, Nebraska, and Kansas. Use intensity and spatial distribution varied by year. For example, Nebraska was a high intensity use state in 2011 and 2012, but not in 2013 and 2014. Pymetrozine use was highest in 2012 (estimated at 30,000 pounds of active ingredient, lbs. a.i.), and decreased by about 10,000 lbs. a.i. in 2014 (**Figure 2**). A Screening Level Usage Analysis (SLUA)[5] report for pymetrozine use indicates that between the reporting years of 2005 – 2014, the major uses included potatoes (average of 8,000 lbs. a.i. applied per year), followed by tomatoes, pecans, lettuce, and celery (average of 1,000 lbs. a.i. applied to each per year), ranging from a maximum of 5 to 35 percent crop treated. Non-agricultural data including outdoor Christmas trees and ornamentals were not provided in the SLUA.

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[3] L. Kaufmann et. al. 2004. The serotonergic system is involved in feeding inhibition by pymetrozine. Comparative studies on a locust (Locusta migratoria) and an aphid (Myzus persicae.) *Comp. Biochem. Physiol. C-Toxicol. Pharmacol.* (138) pp 469–483

[4] J. Ausborn et al. 2005. The insecticide pymetrozine selectively affects chordotonal mechanoreceptors *J Exp Biol.* (208) pp. 4451-4466.

[5] U.S. Environmental Protection Agency, Alsadek, J., BEAD *Updated Screening Level Usage Analysis (SLUA) Report for Pymetrozine,* PC# 101103, April 27, 2016.

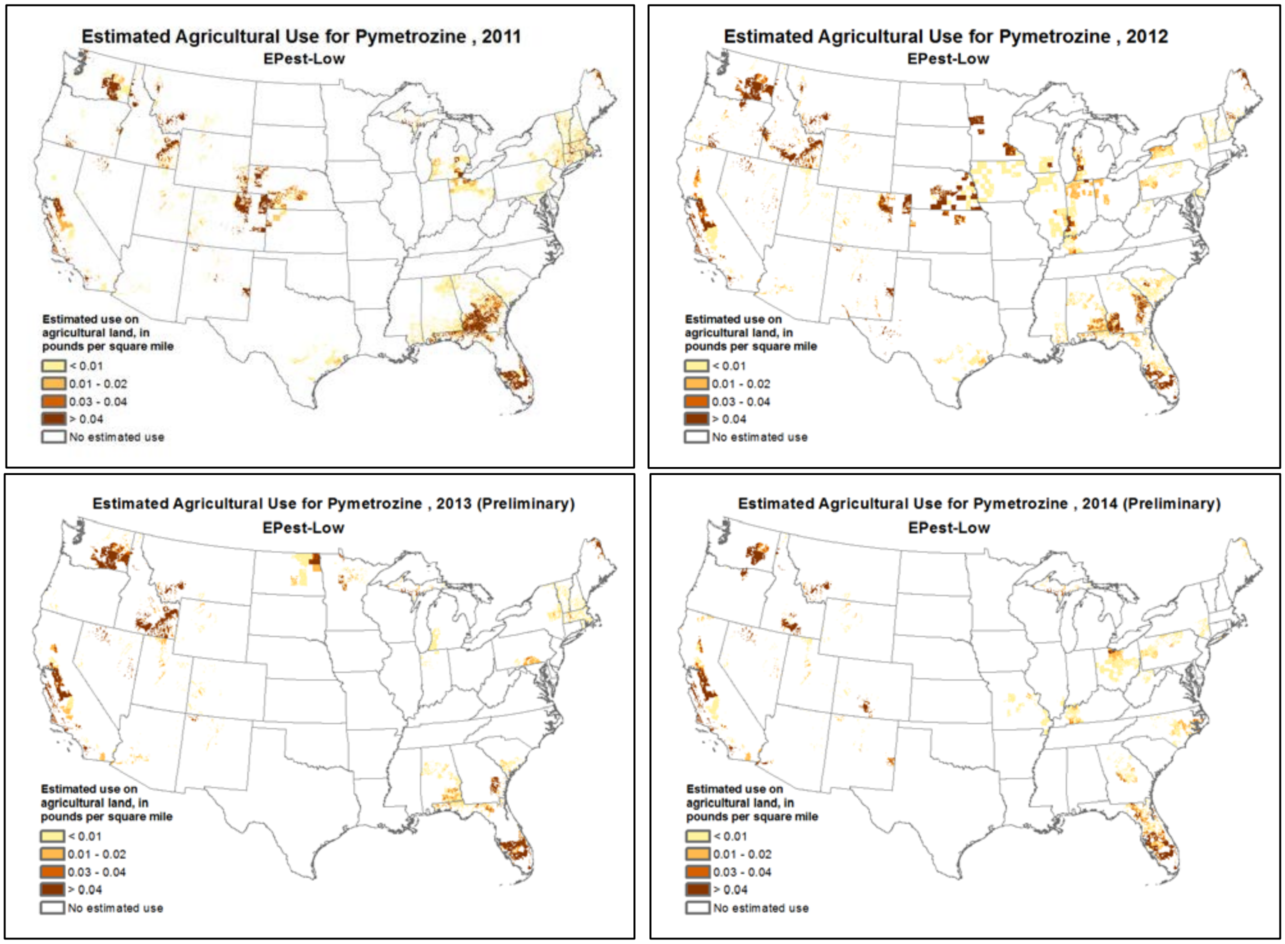


Figure 1. Estimated Distribution of Pymetrozine Use on Agriculatural Crops Nationwide, (USGS, 2017)

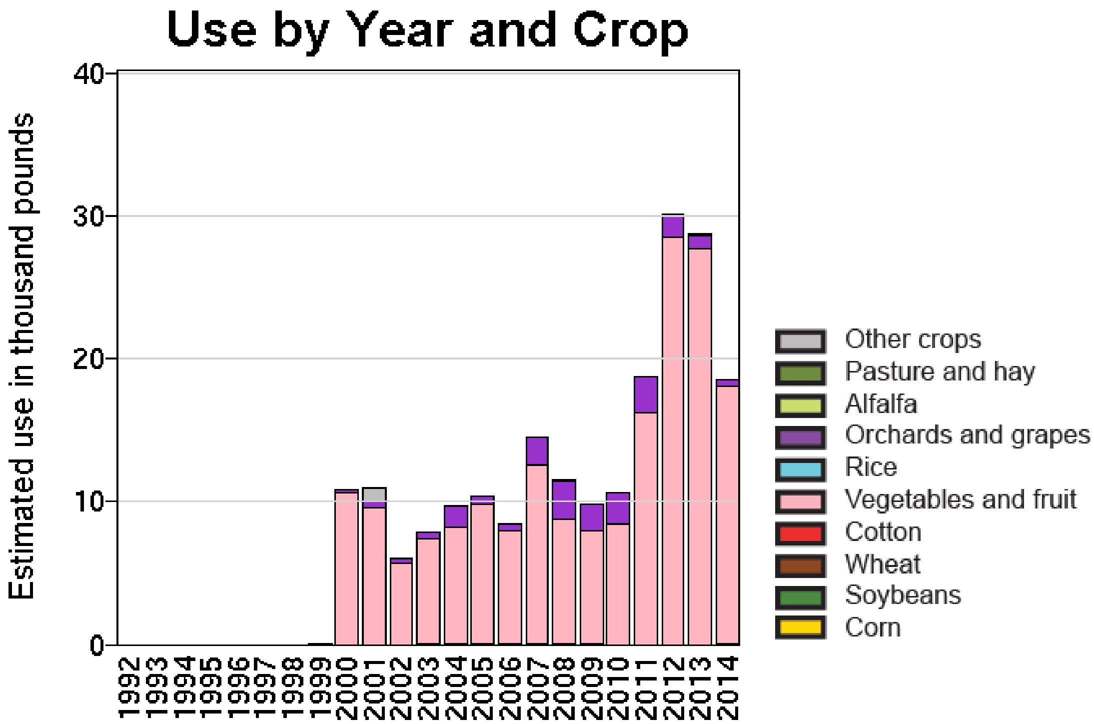


Figure 2. Pymetrozine for Agricultural Use by Year and Crop (USGS, 2017)

For all crops, pymetrozine products are registered for foliar application using either ground equipment or aircraft. Application of pymetrozine through irrigation systems (i.e., chemigation) is only allowed on potatoes, but is prohibited in the state of California. Current registered uses of pymetrozine and application information for each crop or use site is summarized below in **Table 2**.

Table 2. Currently Registered Pymetrozine Uses

Use Site	Application Method	Maximum Single Application Rate (lb a.i./A)	Maximum Number of Applications per Crop Cycle	Maximum Application Rate per Crop Cycle (lb a.i./A)	Number of Crop Cycles Per Year[a]	Maximum Number of Applications per Year	Maximum Application Rate per Year (lb a.i./A)	MRI (days)	REI (hours)	PHI (days)	Comments
ALFALFA (SLNS for ID, MT, OR, UT, WA)	Aerial/ Ground	0.0859	2[b]	0.1719	1	2[c]	0.1719[c]	7	12	NS	Perennial crop with stands living 3-5 years having multiple cuttings per year; however, alfalfa can be grown as part of a crop rotation that may results in more than 2 pymetrozine applications per year.
ASPARAGUS	Aerial/ Ground	0.0859	6[b]	0.5156	1	6[c]	0.5156[c]	30	12	NS	One crop per year, harvested every 1 to 3 days over a 3 to 4-week period. Once established, asparagus field remain in production for 8-10 years.
CHRISTMAS TREES	Ground spray/ Containerized plant	0.3125	NS	NS	1	Outdoor: 5[d] Indoor: 10[d]	Outdoor: 1.5 Indoor: 3.125	7	12	NS	For CA, do not exceed 1.5 lb a.i /A/year for indoor uses
COLE CROPS	Aerial/ Ground	0.0859	2[b]	0.1719	3	6[b]	0.5157	7	12	NS	
COTTON	Aerial/ Ground	0.0859	2[b]	0.1719	1	2[c]	0.1719	7	12	NS	
CUCURBIT VEGETABLES	Aerial/ Ground	0.0859	2[b]	0.1719	1	2[c]	0.1719	7	12	NS	Cucurbits can be grown as part of a crop rotation that may results in more than 2 pymetrozine applications per year.
FRUITING VEGETABLES	Aerial/ Ground	0.0859	2[b]	0.1719	1	2[c]	0.1719	7	12	NS	Fruiting vegetables such as peppers, tomatoes, etc. can be grown as part of a crop

Use Site	Application Method	Maximum Single Application Rate (lb a.i./A)	Maximum Number of Applications per Crop Cycle	Maximum Application Rate per Crop Cycle (lb a.i./A)	Number of Crop Cycles Per Year[a]	Maximum Number of Applications per Year	Maximum Application Rate per Year (lb a.i./A)	MRI (days)	REI (hours)	PHI (days)	Comments
											rotation that may results in more than 2 pymetrozine applications per year.
FRUITS (Nonbearing fruit and nut trees in nurseries)	Ground spray/ Containerized plant	0.3125	NS	NS	1	Outdoor: 5[d] Indoor: 10[d]	Outdoor: 1.5 Indoor: 3.125	7	12	NS	
HOPS	Ground	0.1875	3	0.5625		NS	NS	14	12	NS	
LEAFY VEGETABLES	Aerial/ Ground	0.0859	2[b]	0.1719	2	4[c]	0.3438	7	12	NS	Up to 2 crop cycles per year in rotation with other crops is possible in some locations; therefore, more than 4 applications of pymetrozine are possible.
ORNAMENTALS	Ground spray/ Containerized plant	0.3125	NS	NS	1	Outdoor: 5[d] Indoor: 10[d]	Outdoor: 1.5 Indoor: 3.125	7	12	NS	
PECAN	Aerial/ Ground	0.125	2[b]	0.25	1	2[c]	0.25	7	12	NS	
POTATO, WHITE/IRISH	Aerial/ Ground/ Chemigation	0.1719	2[b]	0.3438	1	2[c]	0.3438	7	12	NS	Chemigation applications are prohibited in CA. Potatoes can be grown as part of a crop rotation that may results in more than 2 pymetrozine applications per year.
ROOT AND TUBER VEGETABLES	Aerial/ Ground	0.1719	2[b]	0.3438	1	2[c]	0.3438	7	12	NS	Root and tuber vegetables can be grown as part of a crop rotation that may results in

Use Site	Application Method	Maximum Single Application Rate (lb a.i./A)	Maximum Number of Applications per Crop Cycle	Maximum Application Rate per Crop Cycle (lb a.i./A)	Number of Crop Cycles Per Year[a]	Maximum Number of Applications per Year	Maximum Application Rate per Year (lb a.i./A)	MRI (days)	REI (hours)	PHI (days)	Comments
(Includes Oregon SLN)											more than 2 pymetrozine applications per year.
TOBACCO	Ground	0.0859	2[b]	0.1719	1	2[c]	0.1719	7	12	NS	Tobacco can be grown as part of a crop rotation that may results in more than 2 pymetrozine applications per year.
TOMATO -SLN (FL) for enhanced management of whiteflies in tomatoes	Aerial/ Ground	0.043	4	0.1719	1	NS	NS	14	12	NS	Tomato can be grown as part of a crop rotation that may results in more than 4 pymetrozine applications per year.
TOMATO -SLN (FL) for tomatoes grown for transplant	Aerial/ Ground	6.6×10^{-3} [e] 1.5 oz product per 100,000 plants	2	0.013[f]	1	2[c]	0.013[c]	7	12	NS	Label says two more apps of 2.75 oz product/A (0.0859 lb a.i./A-the rate on parent label) may be used in the field. Note: because the specific use is for tomatoes grown for transplant, the applications will not be applied to the same field so 4 applications are permitted to the plant but only 2 applications to the same plot of land. Tomato can be grown as part of a crop rotation or multi-crops per year; therefore, more than 2 pymetrozine applications per year may be possible to one plot of land.

Use Site	Application Method	Maximum Single Application Rate (lb a.i./A)	Maximum Number of Applications per Crop Cycle	Maximum Application Rate per Crop Cycle (lb a.i./A)	Number of Crop Cycles Per Year[a]	Maximum Number of Applications per Year	Maximum Application Rate per Year (lb a.i./A)	MRI (days)	REI (hours)	PHI (days)	Comments
VEGETABLES grown for seed- SLN label (WA)	Aerial/ Ground	0.0859	2[b]	0.1719	3	6[c]	0.5157	7	12	NS	
a. The number of crop cycles per year was derived from the "Maximum Number of Crop Cycles per Year in California for Methomyl Use Sites" memo.[6] b. Not specified on the label; however, assumed the maximum application rate per crop cycle divided by the maximum single application rate. c. Not specified on the label; however, assumed the maximum number of applications per crop cycle multiplied by the number of crop cycles possible per year. d. Not specified on the label; however, assumed the maximum single application rate divided by the maximum yearly application rate. e. 0.75 oz a.i. (50% by weight)/100,000 plants*1.36 g/0.034 oz*1lb/453.6=6.6 x 10^{-7} lb a.i./plant; 6.6 x 10^{-7} lb a.i./plant *10,890 plants/acre[7] = 6.6 x10^{-3} lb a.i./A f. Calculated based on 2 applications per crop cycle Not specified (NS) on the label, REI- Restricted entry interval, PHI – Pre-Harvest interval, MRI – Minimum retreatment interval											

[6] U.S. Environmental Protection Agency, M. Kaul, *Maximum Number of Crop Cycles Per Year in California for Methomyl Use Sites*, February 28, 2007.
[7] U.S. Environmental Protection Agency, Becker, J., Ratnayake, S. *Acres Planted per Day and Seeding Rates of Crops Grown in the United States*, March 24

Previous Drinking Water Assessments

Pymetrozine was registered in 1999. The first DWA was conducted at the time of the new chemical assessment[8], and was subsequently updated for some new uses. Exposure estimates for surface water and groundwater from these assessments are highlighted in **Table 3** and **Table 4**, respectively. Using the PRZM/EXAMS[9] model to estimate potential concentrations of pymetrozine (only) in surface water from past assessments, hops had the highest peak surface water concentration at 13.6 µg/L, and the 1-in-10-year average EDWC was 2.7 µg/L. Using the SCI-GROW[9] model to estimate potential residues in groundwater, potatoes had the highest EDWC of 0.019 µg/L.

A TTR approach was used in 2004 for the new use assessment for asparagus. This approach included pymetrozine and one degradate of concern: CGA 359009. In surface water, the 1-in-10 year peak concentration was 16.3 µg/L, the 1-in-10 year annual average concentration was 10.1 µg/L, and the 30-year average yearly concentration was 6.0 µg/L. In groundwater, both the peak and yearly mean concentrations were 0.038 µg/L. The most recent DWA in 2006, assessed the proposed label change to double the application rate used on potatoes and other tuberous root and corn vegetables, and only examined parent-only EDWCs.

[8] U.S. Environmental Protection Agency, Nguyen, T. L., Carey, S. *EFED New Chemical Environmental Risk Assessment for Pymetrozine*, DP250387, April 21, 1999.
[9] For more information on U.S. EPA models, refer to https://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/about-water-exposure-models-used-pesticide

Table 3. Summary of Prior Drinking Water Assessments for Pymetrozine in Surface Water

Assessment/ Date	Crop Scenario	Model Used	Pymetrozine			Pymetrozine and CGA 359009 (TTR Approach)		
			1-in-10 Year Peak Concentration µg/L (ppb)	1-in-10 Year Annual Average Concentration µg/L (ppb)	30 Year Average Yearly Concentration µg/L (ppb)	1-in-10 Year Peak Concentration µg/L (ppb)	1-in-10 Year Annual Average Concentration µg/L (ppb)	30 Year Average Yearly Concentration µg/L (ppb)
Emergency Exemption DP244341 and DP244342 3/1998	WI Potato[a]	GENEEC	2.05	1.12[b]				
Emergency Exemption DP257655 7/1999	CA Lettuce	PRZM/EXAMS	2.13	1.1[c]	0.422			
Emergency Exemption DP266902 7/2000	GA Pecans	GENEEC	4.0	2.3[b]				
Revised Assessment DP275123 6/2001	Hops	FIRST	13.6	2.7[d]				
	Cotton		1.2	0.24[d]				
Refined Assessment D275123 11/2001	Cotton	PRZM-EXAMS	0.73	0.2[d]				
	Cucurbit		3.1	0.7[d]				
	Tomato		3.7	0.8[d]				
	Cabbage		4.4	0.9[d]				
	Pecan		5.2	1.6[d]				
	Hops		2.7	1.1[d]				
New Use Assessment DP283937 10/2004	Asparagus[e]	PRZM-EXAMS	9.0	4.2	2.5	16.3	10.1	6.0
New Use Assessment DP321675 7/2006	Potatoes	PRZM-EXAMS	7.1	1.8	1.4			

a. 0.086 lb a.i./A; 2 applications; 7-day application interval
b. 56-day average concentration
c. 60-day average concentration
d. Annual average
e. The maximum single application rate (Maximum single application rate 0.172 lb a.i./A; Maximum application rate per season 0.516 lb a.i./A) assessed is higher than the maximum single application rate currently registered for asparagus (Maximum single application rate 0.0859 lb a.i./A; Maximum application rate per season 0.516 lb a.i./A).

Table 4. Summary of Prior Drinking Water Assessments for Pymetrozine in Groundwater

Assessment	Crop	Model Used	Concentration µg/L (ppb)	
			Pymetrozine	Pymetrozine & CGA 359009 (TTR Approach)
Emergency Exemption DP244341 and D244342 3/1998	WI Potato	SCI-GROW	0.019	
Emergency Exemption DP257655 7/1999	CA Lettuce	SCI-GROW	0.015	
Emergency Exemption DP266902 7/2000	GA Pecans	SCI-GROW	0.015	
New Use Assessment DP283937 10/2004	Asparagus	SCI-GROW	0.016	0.038

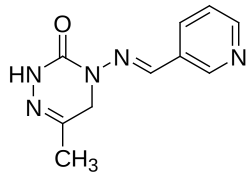
EXPOSURE CHARACTERIZATION

Physical-Chemical Properties of Pymetrozine

The chemical structure of pymetrozine is comprised of a pyridine and triazine ring. The low Henry's Law Constant (< 3.0 x 10^{-6} Pa m^3/mol), coupled with a relatively high soil:water partitioning coefficient (6.55 to 30.9 in a range of soils), as well as the low vapor pressure (3.0 x 10^{-8} mmHg at 25 °C), indicate that pymetrozine volatilization is insignificant. The low octanol:water partition coefficient (log $K_{ow} =$ -0.18 at 25 °C) suggests that pymetrozine will not bioaccumulate. Pymetrozine is water soluble at 290 mg/L (25 °C; pH 6.5). Pymetrozine is slightly mobile in soil based on measured adsorption constants and FAO[10] mobility classification. The physical-chemical properties of pymetrozine are listed in **Table 5**.

[10] Food and Agriculture Organization of the United Nations

Table 5. Pymetrozine Physical-Chemical Properties

Parameter	Identifier
Chemical Structure	
Chemical Name	(4,5-dihydro-6-methyl-4-[(3-pyridinylmethylene) amino]-1,2,4-triazine-3(2H)-one); 1,2,4-triazin-3(2H)-one, 4,5-dihydro-6-methyl-4-[(3-pyridinylmethylene) amino]
SMILES	O=C1NN=C(C)CN1N=Cc2cccnc2
Chemical Abstracts Service (CAS) Registry Number	123312-89-0
Company Code	CGA 215944
Molecular Formula	$C_{10}H_{11}N_5O$
Molecular Weight	217.23 g/mol
Vapor Pressure (25 °C)[a]	5.0×10^{-6} Pa; 3.0×10^{-8} mmHg (25 °C); < 9.7×10^{-8} Pa (20 °C)[a]
Water Solubility	290 mg/L (25 °C; pH 6.5); 270 mg/L (20 °C)[a]
Henry's Law Constant	< 3.0×10^{-6} Pa m^3/mol
Soil:Water Partitioning Coefficient (Kd)	6.55 – 30.9[c]
Log octanol-to-water partition coefficient (Log K_{ow}[a])	-0.18 (25 °C)[b]
Adsorption Constant (K_{oc})	1,394 – 7,875[e]; 9 – 1,310[d] mL/g-OC
Log acid dissociation constant (pKa)	pk_{a1} = 4.06[b]

a. MRID 44024963
b. Pymetrozine Problem Formulation. March 20, 2013.
c. MRID 44024969
d. EPISuite v. 4.0 Soil Adsorption Coefficient based on MCl and K_{ow} Method
e. MRIDs 44024970, 44024971, 44024972

MRIDs 44024901 and 44024904 provide pymetrozine solubility data for a number of common solvents.

Environmental Fate Properties of Pymetrozine

Major routes of environmental dissipation of pymetrozine following application include spray drift and runoff on eroded sediment/soil as well as transformation. As a result, pymetrozine and pymetrozine transformation products may reach surface waters used as source drinking water. A major route of transformation is expected to be through aqueous photolysis in clear and shallow waterbodies (half-life = 3 days); however, in deep ponds, lakes, or reservoirs, anaerobic aquatic metabolism is expected to dominate the dissipation processes (half-life = 89 days). Pymetrozine transformation via aerobic aquatic metabolism ranges in half-lives of 15 to 527 days. Hydrolysis was only observed in acidic conditions (pH ≤ 5) with a half-life of 23 days; pymetrozine is persistent in neutral and basic aqueous environments. Pymetrozine is stable to soil photolysis, though there are inconsistencies in the data. Microbial-mediated transformation is biphasic, described by a quick rate of decline, followed by a slower rate until study termination. Laboratory aerobic soil metabolism half-lives range from 4 to 238 days. In most studies, pymetrozine was mineralized to carbon dioxide by microbial activity, ranging from 22% to 73% of the applied radioactivity by study termination. Environmental fate properties for pymetrozine are summarized in **Table 7**.

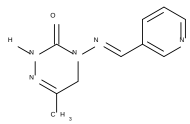
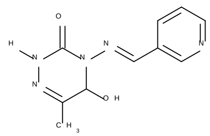
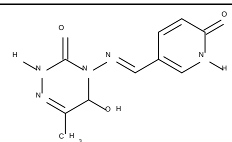
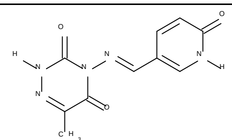
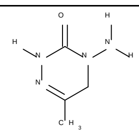
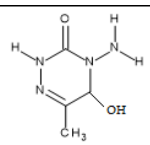
It is not as likely for parent pymetrozine to be found in groundwater used as source drinking water as it is not expected to leach very deep through the soil profile. However, in areas with karst soils or where macro particle transport through the soil occurs, or in cases of a shallow water table, pymetrozine could reach groundwater. Pymetrozine was observed to be slightly mobile under actual use conditions in field studies located in California, Georgia, and New York. These half-life values were biphasic and ranged from 39 to 269 days, and were consistent with laboratory metabolism studies. Two field lysimeter studies detected pymetrozine primarily within the surface soil horizons, but as deep as 30 inches, and also in the leachate.

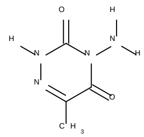
Batch equilibrium studies indicate relatively high adsorption of pymetrozine to soil for all soils tested, and approximately 90% of pymetrozine adsorption occurred within the first two hours. Clay content had the strongest relationship to pymetrozine adsorption (r^2 = 0.87). Organic matter, cation exchange capacity, and pH also directly relate to pymetrozine adsorption. According to the FAO Mobility Classification Scale, and based on study-specific K_{oc} values (1,394 – 7,875 mL/g-OC; n=6) from batch equilibrium studies, pymetrozine is considered slightly mobile in soil (average K_{oc}= 3,936 mL/g-OC). Likewise, column leaching studies of parent and aged parent indicate that pymetrozine exhibits slight mobility to no mobility in sand, sandy loam, loam, and silty clay loam soil columns.

Environmental Fate Properties of Residues of Concern

Pymetrozine transforms into a total of 17 compounds, not including unidentified and unextracted residues. However, of these 17 transformation products, EFED and HED during ROCKS review, concluded that parent plus a total of six (6) transformation products should be considered residues of concern based on environmental fate data suggesting that they may reach surface and/or groundwater and potential human health concerns. Three of the six degradates retain both the pyridine and triazine moieties: CGA 359009, CGA 363431, and CGA 363430, and three retain the triazine moiety with an attached nitrogen: CGA 215525, Hydroxy CGA 215525, and CGA 294849, and are summarized in **Table 6**. TTR half-lives are reported from only the triazine-labeled studies. These studies track degradates of concern that retain both moieties, as well as the triazine daughter degradates. Environmental fate properties for pymetrozine and TTR are summarized in **Table 7**.

Table 6. Pymetrozine Transformation Products Expected to be of Exposure Concern in Source Drinking Water

Parent and Major Transformation Products	Structure	Moiety	Molecular Formula	Solubility (mg/L)[a]	Log octanol:water partition coefficient (Log K_{ow})	Adsorption Constant (K_{oc}) mL/g-OC	FAO Mobility Classification[b]	Potential SW/GW Concern	Notes
CGA 215944 (Parent)		Both	$C_{10}H_{11}N_5O$	290	-0.18	1,394 – 7,875 [c, e]	Slightly mobile	SW only	Not likely a groundwater concern, may be a surface water concern.
CGA 359009		Both	$C_{10}H_{11}N_5O_2$	101,900	-0.65	284 – 436[c]	More mobile	SW and GW	34%, 55%, 18% from Soil photolysis, Aerobic soil, and Aerobic aquatic studies
CGA 363431		Both	$C_{10}H_{11}N_5O_3$	33,630	-1.71	0.3 – 20[d]	Much more mobile	SW and GW	23% Aerobic soil studies
CGA 363430[*]		Both	$C_{10}H_9N_5O_3$	3,732	-0.58	4 – 63[d]	Much more mobile	SW and GW	9% Aerobic soil studies
CGA 215525		Triazine	$C_4H_8N_4O$	79,780	-1.45	2 – 4[d]	Much more mobile	SW and GW	48%, 79% from Hydrolysis and Aq. Photolysis studies
Hydroxy CGA 215525		Triazine	$C_4H_9N_4O_2$	1,000,000	-2.99	0.15 – 10[d]	Much more mobile	Not likely	10.2% Aqueous photolysis studies, 9% Aerobic soil studies, 20% Anaerobic aquatic studies

Parent and Major Transformation Products	Structure	Moiety	Molecular Formula	Solubility (mg/L)[a]	Log octanol:water partition coefficient (Log K_{ow})	Adsorption Constant (K_{oc}) mL/g-OC	FAO Mobility Classification[b]	Potential SW/GW Concern	Notes
CGA 294849		Triazine	$C_4H_6N_4O_2$	37,510	-1.14	4 – 10[d]	Much more mobile	SW and GW	10% Aerobic aquatic studies

[*] Considered a major degradate at 9% maximum applied radioactivity
a. Solubility of metabolites calculated from EPISuite v. 4.0, Log K_{ow} (WSKOW v. 1.41)
b. More mobile, or much more mobile compared to parent mobility
c. Koc from laboratory batch equilibrium studies
d. Koc estimated using EPISuite v. 4.0 based on MCl and K_{ow} Method
e. EPISuite v. 4.0 estimate of parent K_{oc} = 9 to 1,310
SW: Surface water; GW: Groundwater; Percentages represent maximum percent of applied radioactivity; FAO: Food and Agriculture Organization of the United Nations

Based on available batch equilibrium data and EPISuite[11] estimates, all of these transformation products are expected to be more mobile than parent pymetrozine. The precise estimates of EPISuite derived data are uncertain as EPISuite mobility estimates for parent-pymetrozine indicate pymetrozine to be more mobile than batch equilibrium studies indicate. For example, actual K_{oc} values from batch equilibrium studies for parent mobility ranged from 1,394 to 7,875 mL/g-OC, whereas EPISuite estimates of parent mobility ranged from 9 to 1,310 mL/g-OC. EPISuite estimated mobility (K_{oc}) for all of the degradates of concern range in values of < 2 to 63 mL/g-OC, but based on the parent mobility example, these degradates may not be as mobile as estimated; however, these transformation products are expected to be more mobile than parent. CGA 359009 is the only degradate of concern with measured K_{oc} values. It is more mobile than parent and is classified as moderately mobile (K_{oc} 284 to 436 mL/g-OC; average: 320 mL/g-OC; 1/n = 0.74 –0.86) in soil. EPISuite estimates CGA 359009 as more mobile than empirical results indicate, in the range from 2 to 105 mL/g-OC.

While the precise mobility parameters of the other transformation products are unknown, pymetrozine-TTR are expected to leach through the soil profile into groundwater. Additional mobility data would permit a better estimation of the potential mobility; however, these data are not expected to substantially alter the exposure conclusions.

Based on limited available data, these degradates may be more persistent in the environment than parent pymetrozine. Laboratory data implies that CGA 359009 may not be persistent; however, it was detected in field lysimeter leachate. CGA 359009 is a major transformation product in many studies, but generally declines in percent applied radioactivity over time. An aerobic soil study suggests CGA 359009 degrades quicker than parent with a half-life of 2.5 days, and in a batch equilibrium study, CGA 359009 was not stable for the full 24-hour equilibrium period, so a 4-hour equilibrium period was used to assess adsorption/desorption properties. CGA 359009 was not observed to leach beyond the top 6 inches of the soil profile in terrestrial field dissipation studies. However, contrary to these studies, it was quantified in lysimeter leachate (0.06%), roughly comparable to depths of 18-24 inches. CGA 359009 is the only degradate of concern with actual measured K_{oc} values as described above.

CGA 363431 is a major transformation product in aerobic soil metabolism studies with residues exceeding 10% of applied at study termination (363 days) in one soil study. Based on EPISuite estimates (K_{oc} of 0.3 to 20) this transformation product is expected to be much more mobile than parent.

CGA 363430 is an aerobic soil transformation product observed at a maximum concentration of 9% applied radioactivity, but remained at similar concentrations at study termination (363 days). Although this product falls below the “rule-of-thumb” major degradate cut off of ≥ 10% applied radioactivity, these concentrations were observed late in the study when sampling intervals are spaced further apart, and as such, concentrations may have exceeded 10% of the applied material during a non-sampling interval. Based on EPISuite estimates (K_{oc} of 4 to 63), this transformation product is expected to be much more mobile than parent.

CGA 294849 was observed to form in all environmental fate studies except for hydrolysis, however, it was the only a major transformation product in the aerobic aquatic metabolism study. The quantity of CGA 294849 was found to decrease overtime. It had a maximum percent applied radioactivity of 10%, 14 days into the study, but decreased to 1.4% by study termination (102 days). This degradate is expected to be

[11] EPISuite v. 4.0. The Estimation Programs Interface (EPI) Suite TM was developed by USEPA OPPT and Syracuse Research Corporation (SRC). EPI Suite TM cannot be used for all chemical substances.

mobile (K_{oc} of 4 to 10) in soil, based on EPISuite estimated values. In a terrestrial field dissipation study, there was one sample detection of CGA 294849 at 6 to 12 inches below ground surface. CGA 294849 was also the most prominent transformation product (0.35%) quantified in lysimeter leachate, roughly comparable to depths of 18-24 inches.

CGA 215525 persistence data is inconsistent. CGA 215525 was quantified at a maximum concentration of 48% and 79% in hydrolysis and aqueous photolysis studies, respectively. CGA 215525 remained above 30% of applied radioactivity at study termination in both studies, indicating potential persistence. Conversely, adsorption and desorption properties of CGA 215525 could not be assessed in batch equilibrium because it was unstable in soil even within 2 hours of testing. Although CGA 215525 was not observed at depths greater than 6 inches in terrestrial field dissipation studies, it is expected to be much more mobile (K_{oc} of 2 to 4) than parent in soil, based on EPISuite estimated values. CGA 215525 transforms into another degradate of concern: CGA 294849.

Hydroxy CGA 215525 (CGA 215525-OH) persistence data is inconsistent. It is observed in aquatic photolysis, anaerobic aquatic metabolism, and aerobic soil metabolism studies. In an aquatic photolysis study, Hydroxy CGA 215525 steadily increased in percent applied radioactivity over time to a maximum of 10% at study termination (30 days). It reached a maximum of 20% from an anaerobic aquatic study at study termination. It was also detected in an aerobic soil metabolism study at a maximum of 9%, 15 days into the study, but decreased to non-detect at study termination (120 days). Adsorption and desorption properties of CGA 215525-OH could not be assessed in batch equilibrium because it was unstable in soil even within 2 hours of testing. CGA-215525-OH may transform into another residue of concern: CGA 294849. Hydroxy CGA 215525 is expected to be much more mobile than parent based on EPISuite estimates (K_{oc} of 0.15 to 10).

All six of these residues, plus parent, are considered in this DWA, and are referenced as pymetrozine-TTR.

Table 7. Environmental Fate Summary Table for Pymetrozine and TTR

Study	System Name/ Characteristics	Representative Half-life Value --Value Used to Derive Model Input Values (days)[1]--		Source/ Classification	Comments
		Pymetrozine	TTR[2]		
Hydrolysis	pH 5, 25 °C[5]	$t_{1/2}$ = 23	NA	835.2010 MRID 44024962 MRID 44024963	Triazine ring labeled studies. Hydrolysis was observed to be biphasic, thus the results may not be reliable.
	pH 7, 25 °C	$t_{1/2}$ = 616 $t_{1/2}$ = 795	Stable	835.2010 MRID 44024963 MRID 44024964	Pyridine and triazine ring labeled studies. Degradates were not analyzed in pH 7 system, but assumed as stable

Study	System Name/ Characteristics	Representative Half-life Value --Value Used to Derive Model Input Values (days)[1]--		Source/ Classification	Comments
		Pymetrozine	TTR[2]		
Aqueous Photolysis	pH 7, 25 °C, Equivalent time at 40 °N	$t_{1/2}$ = 3 $t_{1/2}$ = 2 $t_{1/2}$ = 2	$t_{1/2}$ = 52 $t_{1/2}$ = 8	835.2240 MRID 44411321 MRID 44411322 MRID 44471702	Pyridine and triazine ring labeled studies.
Soil Photolysis	Silt Loam, pH 7, 23 °C, Equivalent time at 40 °N Sandy Loam, pH 7.5, 25° C, Equivalent time at 40° N	Stable	Stable	835.2410 MRID 44411324 MRID 44411325 MRID 45208701 MRID 45208702	Pyridine and triazine ring labeled studies.
Aerobic Soil Metabolism	California Sandy Loam pH 7, 25 °C 0.3% OM CEC: 4.6 meq/100g 5 grams of soil tested	Slow $t_{1/2}$ = 238 Slow $t_{1/2}$ = 238	Slow $t_{1/2}$ = 711 Slow $t_{1/2}$ = 436	835.4100 MRID 44024965 MRID 44024966	Pyridine and triazine ring labeled studies.
	UK Sandy clay loam pH 6.1, 20 °C 2.5% OC 4.3% OM CEC: 18.9 meq/100g 100 g of soil tested	Slow $t_{1/2}$ = 4	$t_{R\ IORE}$ = 16	835.4100 MRID 49921301 Supplemental	Pyridine and triazine ring labeled studies.
	Switzerland Silt loam soil pH 7.30, 20 °C 2.1% OC 3.62% OM CEC: 14 mmol/Z/ 100g 200 g of soil tested	$t_{R\ IORE}$ = 14	NA	835.4100 MRID 49921303 Supplemental	Pyridine ring labeled study.
	Switzerland Sandy loam soil pH 7.20, 20 °C 1.7% OC 2.93% OM CEC: 11.9 mmol/Z/100g 200 g of soil tested	$t_{R\ IORE}$ = 4	NA		Pyridine ring labeled study.
Anaerobic Soil Metabolism		NA			Results from the anaerobic aquatic metabolism study can be used to fulfill this data requirement.

Study	System Name/ Characteristics	Representative Half-life Value --Value Used to Derive Model Input Values (days)[1]--		Source/ Classification	Comments
		Pymetrozine	TTR[2]		
Aerobic Aquatic Metabolism	Weweantic River, Massachusetts water:sand sediment 20°C water pH 6.5, sediment pH 5.2	$t_{R\ IORE}$ = 15	$t_{R\ IORE}$ = 30	835.4300 MRID 49921304 Supplemental	Pyridine and triazine ring labeled studies. Both water and sediment were suboxic throughout the experiment. Material balances decreased as low as 84.0% in the samples treated with the pyridinyl label. The study author attributed the low material balances in part to a leak in the volatile trapping system.
	Switzerland Pond water:silt loam sediment 20°C, water pH not reported, sediment pH 6.80 - 7.10	Slow $t_{1/2}$ =321	Slow $t_{1/2}$ =419	835.4300 MRID 49921305 Supplemental	Triazine ring labeled study.
	Switzerland River water:silt loam sediment 20°C, water pH not reported, sediment pH 6.80 - 7.10	Slow $t_{1/2}$= 379	Slow $t_{1/2}$ =499		
	Switzerland Pond water:silt loam sediment, 20°C, water pH not reported, sediment pH 6.80-7.10	Slow $t_{1/2}$ = 527	NA	835.4300 MRID 49921306 Supplemental	Pyridine ring labeled study.
	Switzerland River water:silt loam sediment, 20°C, water pH not reported, sediment pH 6.80-7.10	Slow $t_{1/2}$ = 403			

Study	System Name/ Characteristics	Representative Half-life Value --Value Used to Derive Model Input Values (days)[1]--		Source/ Classification	Comments
		Pymetrozine	TTR[2]		
Anaerobic Aquatic Metabolism	Flooded Sandy Loam 25 °C, water pH 8.3-8.5, soil pH 7.4	$t_{1/2}$ = 89	$t_{1/2}$ = 177 $t_{R\ IORE}$ = 123	835.4400 MRID 44024967 MRID 44024968	Pyridine and triazine ring labeled studies. Both anaerobic aquatic metabolism studies utilized the same test system. The 3x factor was not employed.
Terrestrial Field Dissipation	Bareground Plot California Sandy loam (748 g ai/A) 0-6”	Slow $t_{1/2}$ = 261	Slow $t_{1/2}$ = 231	835.6100 MRID 44411338, MRID 44647903, MRID 45387802	Application rate is 110% of proposed max annual rate for tree crops. Reported half-lives represent the top 6” of soil.
	Tomato Plot California Sandy loam (748 g ai/A) 0-6”	$t_{1/2}$ = 259	$t_{1/2}$ = 257		
	Bareground Plot Georgia Loamy sand (0-6”) Sandy loam (6-12”) Sandy clay loam (12-48”) (748 g ai/A)	$t_{R\ IORE}$ = 73	---	835.6100 MRID 44471703 MRID 44647904 MRID 45387803 (Method determination and Independent Lab Validation: MRID 44411333 MRID 44411337 MRID 44411339 MRID 44411332 MRID 44411336 MRID 44411335)	Storage stability studies indicated some decline in stability of parent by 11 months. Reported half-lives represent the top 6” of soil.
	Cotton Plot Georgia Loamy sand (0-6”) Sandy loam (6-12”) Sandy clay loam (12-48”) (748 g ai/A)	$t_{R\ IORE}$ = 42	Slow $t_{1/2}$ = 146		

Study	System Name/ Characteristics	Representative Half-life Value --Value Used to Derive Model Input Values (days)[1]--		Source/ Classification	Comments
		Pymetrozine	TTR[2]		
	Bareground Plot New York Loam (0-18”) Silt loam (18-42”) (748 g ai/A)	$t_{R\ IORE}$ = 39	$t_{R\ IORE}$ = 104	835.6100 MRID 44411334 MRID 44647901 MRID 44647902 MRID 45387801	
	Lysimeter Bareground Plot Georgia Sandy loam (748 g ai/A)	Slow $t_{1/2}$ = 113	Slow $t_{1/2}$ = 113	835.6100 MRID 44411340 MRID 45208704	Pyridine and triazine ring labeled studies. Lysimeter-enclosed (8” diameter, 18 to 36” below ground surface). Reported half-lives are from 0-3” of soil. Mobility in soil was 18-24” for both labels. Both labels detected in leachate.
	Lysimeter California Sandy Loam (Tujunga) (748 g ai/A)	Slow $t_{1/2}$ = 200	Slow $t_{1/2}$ = 191	835.6100 MRID 44411341 MRID 45208705	Pyridine and triazine ring labeled studies. Total water received by the lysimeters was approximately 355% of the typical cumulative rainfall for the region. The triazine moiety was detected at a maximum depth of 24-30”. The pyridine ring labeled moiety was detected at a maximum depth of 12-18”. Only triazine labeled degradates detected in leachate.

1. The value used to estimate a model input value is the calculated SFO DT_{50}, T_{IORE}, or the 2nd DT_{50} from the DFOP equation. The model chosen is consistent with that recommended using the, *Guidance for Evaluating and Calculating Degradation Kinetics in Environmental Media*, Health Canada, U.S. Environmental Protection Agency, December 21, 2012. The equations can be found in the document, *Standard Operating*

Study	System Name/ Characteristics	Representative Half-life Value --Value Used to Derive Model Input Values (days)[1]--		Source/ Classification	Comments
		Pymetrozine	TTR[2]		

Procedure for Using the NAFTA Guidance to Calculate Representative Half-life Values and Characterize Pesticide Degradation, U.S. Environmental Protection Agency, November 30, 2012.

2. TTR half-lives are reported from only triazine ring labeled studies, because the pyridine ring labeled studies do not track all degradates of concern.

Drinking Water Conceptual Model

An illustration of potential pesticide dissipation routes in the environment is depicted in **Figure 3**. Pymetrozine may reach surface water through spray drift. Although foliar interception may reduce the amount of pymetrozine available for runoff, it is believed that pymetrozine could reach surface waters through penetration of the foliar canopy, and onto soil or standing water during application, as well as foliar wash off followed by runoff. The soil:water partitioning of pymetrozine indicates that it is slightly mobile and that runoff will primarily occur via soil or sediment transport; however, some dissolution in runoff water is possible as soil:water partitioning is an equilibrium process.

It is not as likely for parent pymetrozine to be found in groundwater used as source drinking water as it is not expected to leach very deep through the soil profile. However, in areas with karst soils or where macro particle transport through the soil occurs, or in cases of a shallow water table, pymetrozine could reach groundwater.

While data are limited, TTR is expected to be much more mobile than parent pymetrozine. As such, these residues are likely to runoff to surface water bodies as well as leach to groundwater resulting in exposure via drinking water (refer to **Table 6**).

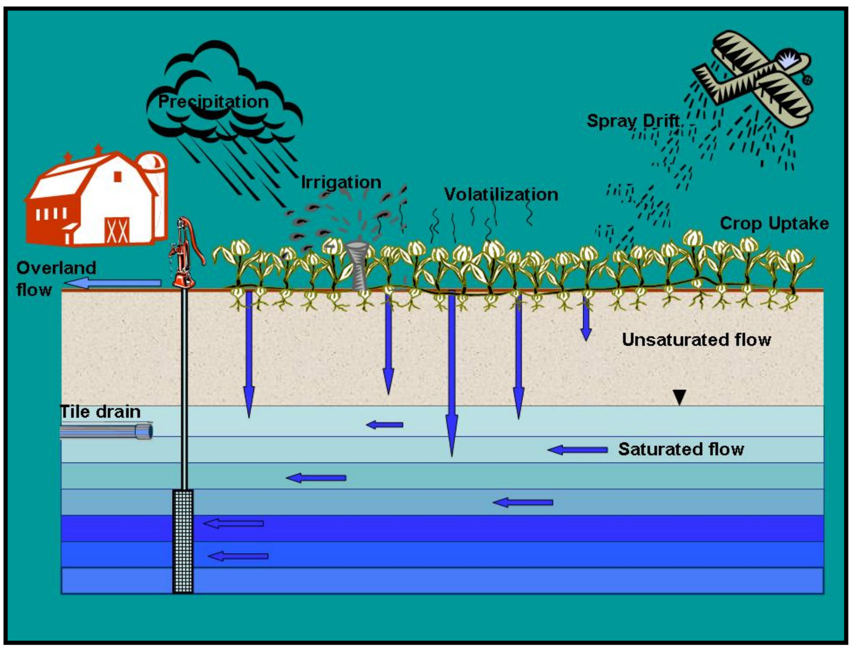


Figure 3. Probable Routes of Pesticide Dissipation in the Environment

The EDWCs in surface water were estimated in batch mode with the PRZM5 and VVWM models in the operating platform of Pesticide Water Calculator (Version 1.52). PRZM5 simulates pesticide fate and transport as a result of leaching, direct spray drift, runoff and erosion from an agricultural field. The VVWM model simulates pesticide loading via runoff, erosion, and spray drift assuming a standard watershed of 172.8 ha that drains into an adjacent standard drinking water index reservoir of 5.26 ha, an average depth of 2.74 m (Jones et al., 2000). Simulations for drinking water used the Index Reservoir scenario in the VVWM, which is a surrogate for a drinking water source drawn from a surface water source (USEPA, 2000).

Weather and agricultural practices are simulated for 30 years so that the 1 in 10-year exceedance probability at the site can be estimated. The simulation was generated using the 30 years of meteorological data, encompassing the years from 1961 to 1990.

Groundwater concentrations are estimated using the PRZM-GW[12] (Version 1.52) model in the Pesticide Water Calculator (Version 1.52). PRZM-GW uses leaching algorithms (tipping bucket) from the PRZM model to predict pesticide leaching into shallow, unconfined groundwater on vulnerable sites (i.e., sandy soils). The model construct assumes that the aerobic soil metabolism rate decreases linearly to a 1-meter depth in the surface soil; thereafter, abiotic hydrolysis is the only degradation process deeper than 1 meter. Currently, six regionally-specific scenarios of vulnerable soils are utilized in groundwater modeling.

Analysis

Environmental fate data parameters used in the surface and groundwater modeling were selected from the submitted studies in general accordance with *Guidance for Selecting Input Parameters in Modeling the Environmental Fate and Transport of Pesticides*, Version 2.1, October 22, 2009. Environmental fate data used in pymetrozine and TTR modeling are shown in **Table 8**.

Pymetrozine is used on multiple crops, thus an all-agricultural percent crop area (PCA) [13] factor of 1.0 was used to account for the percentage of agricultural crops that pymetrozine may be applied to, within a watershed (USEPA, 2014).

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[12] Detailed description, documentation, and direct links for running these models can be found in: https://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/about-water-exposure-models-used-pesticide

[13] Brady, 9/12/2014, Development of Community Water System Intake Percent Cropped Area Adjustment Factors for Use in Drinking Water Exposure Assessments, September 12, 2014.

Table 8. Model Input Parameters for Parent and TTR for Assessing Drinking Water Exposure

Fate Property	Pymetrozine Input Value	TTR Input Value[a]	Comment	Data Source
Molecular Weight	217.23 g/mol		Parent input parameters used as proxy for TTR	MRID 44024963
Henry's constant	< 3.0 x 10^{-6} Pa m^3/mol			MRID 44024963
Vapor Pressure	3.0 x 10^{-8} mmHg (25 °C)			MRID 44024963
Solubility in Water	290 mg/L (25 °C; pH 6.5)			MRID 44024963
Photolysis in Water	3 days	52 days	The longest half-life from all studies.	MRID 44411321 MRID 44411322 MRID 44471702
Aerobic Soil Metabolism Half-life 25 °C	186 days	769 days	The 90th percentile confidence bound on the mean half-life value determined following the NAFTA kinetics guidance is used for modeling.	MRID 44024965 MRID 44024966 MRID 49921301 MRID 49921303
Hydrolysis at pH 7 40 °N	795 days	0 (stable)	Degradates were not analyzed in the pH 7 system. Parent-only half-life is 795 days (longest half-life), thus it is assumed that TTR half-life would be stable.	MRID 44024964
Aerobic Aquatic Metabolism 20 °C	460 days	589 days	The 90th percentile confidence bound on the mean half-life value determined following the NAFTA kinetics guidance is used for modeling.	MRID 49921304 MRID 49921305 MRID 49921306
Anaerobic Aquatic Metabolism 25 °C	89 days	233 days	The 90th percentile confidence bound on the mean half-life value determined following the NAFTA kinetics guidance is used for modeling.	MRID 44024967 MRID 44024968
Foliar Half-life	0		Default Value	PWC User Guidance[b]
Adsorption Constant (K_{oc}) mL/g-OC	3,963 mL/g	320 mL/g	The mean K_{oc} value is used for modeling. TTR input value is for CGA 359009, which was the only measured data for a degradate of concern, however, estimations suggest that the other residues of concern may be more mobile than the average K_{oc} modeled.	MRID 44024969 MRID 44411326

Spray Drift	0.135 - aerial 0.066 - ground	Spray Drift Guidance[c]	Default values
Application Efficiency	0.95 - aerial 0.99 - ground		Default values

a. TTR half-lives were calculated from only triazine radiolabeled studies.
b. *Guidance for Selecting Input Parameters in Modeling the Environmental Fate and Transport of Pesticides*, Version 2.1, October 22, 2009.
c. U.S. EPA Guidance on Modeling Offsite Deposition of Pesticides via Spray Drift for Ecological and Drinking Water Assessment, December 20, 2013.

Estimated Drinking Water Concentrations in Surface Water

Modeling scenarios and pymetrozine application conditions used in the surface water assessment are provided in **Appendix A**. Representative surrogate scenarios were selected to represent the various crop groups cited on the pymetrozine label and were discussed during consultation with BEAD. Surface water EDWCs were calculated with parent-only inputs as well as pymetrozine-TTR inputs.

EDWCs for parent-only pymetrozine in surface source water are shown in **Appendix B.1**, and are summarized by use in **Table 9.** The highest EDWCs are associated with outdoor Christmas, ornamentals, and fruits (nonbearing fruit and nut trees in nurseries) with five applications at an application rate of 0.3125 lb a.i./A (1.5625 lb a.i./A total). EDWCs for parent pymetrozine in surface source water are not expected to exceed 23 µg/L for the 1 in 10-year daily average, 5 µg/L for the 1 in 10-year annual average, and 3 µg/L for the 30-year annual average.

EDWCs for pymetrozine-TTR in surface source water are shown in **Appendix B.2**, and are summarized by use in **Table 10.** The highest EDWCs are also associated with pymetrozine application to outdoor Christmas, ornamentals, and fruits (nonbearing fruit and nut trees in nurseries) with five applications at a maximum single application rate of 0.3125 lb a.i./A (1.5625 lb a.i./A total). EDWCs for pymetrozine-TTR in surface source water are not expected to exceed 47 µg/L for the 1 in 10-year daily average, 13 µg/L for the 1 in 10-year annual average, and 10 µg/L for the 30-year annual average.

Table 9. Surface Water Estimated Drinking Water Concentrations (Pymetrozine only)

Use Site, Type	PRZM-VVWM		
	1-in-10 Year Concentration (µg/L)		30 Year Annual Average Concentration (µg/L)
	Daily Average	Annual Average	
Alfalfa	1.5	0.5	0.4
Asparagus	1.9	0.9	0.8
Christmas, Ornamentals, and Trees	23	4.5	3.1
Cole Crops and Vegetables Grown for Seed	11	2.2	1.4
Cotton	5.4	0.9	0.7
Hops	2.0	0.9	0.7
Leafy Vegetables	5.9	1.5	1.1
Pecan	3.6	0.7	0.5
Potato, White/Irish, & Root Tuber Vegetables	8.6	1.9	1.5

Tobacco	2.2	0.4	0.2
Tomato – SLN (FL)	2.8	0.6	0.4
Tomato SLN- tomatoes grown for transplant	1.8	0.3	0.2
Vegetables[a] – One Growing Season	3.0	0.6	0.5
Vegetables – Two Growing Seasons	8.2	1.4	1.0
Vegetables – Three Growing Seasons	6.2	1.7	1.3
a) Cucurbit vegetables and fruiting vegetables			

Table 10. Surface Water Estimated Drinking Water Concentrations (Total Toxic Pymetrozine Residues)

Use Site, Type	PRZM-VVWM		
	1-in-10 Year Concentration (µg/L)		30 Year Annual Average Concentration (µg/L)
	Daily Average	Annual Average	
Alfalfa	6.7	3.8	3.0
Asparagus	7.9	6.8	5.5
Christmas, Ornamentals, and Trees	47	13	9.5
Cole Crops and Vegetables Grown for Seed	43	12	7.4
Cotton	17	4.7	2.7
Hops	4.7	2.2	1.8
Leafy Vegetables	22	13	7.7
Pecan	7.9	1.7	0.8
Potato, White/Irish, & Root Tuber Vegetables	26	8.1	5.8
Tobacco	1.9	0.8	0.6
Tomato – SLN (FL)	7.2	1.3	0.8
Tomato SLN- tomatoes grown for transplant	6.3	0.9	0.5
Vegetables[a] – One Growing Season	16	11	7.5
Vegetables – Two Growing Seasons	12	3.6	2.9
Vegetables – Three Growing Seasons	18	7.3	5.1
a) Cucurbit vegetables and fruiting vegetables			

Estimated Drinking Water Concentrations in Groundwater

Groundwater EDWCs were calculated using parent-only inputs and pymetrozine-TTR inputs at the highest maximum labeled rates to outdoor Christmas, ornamentals, and fruits (nonbearing fruit and nut trees in nurseries) with five applications at an application of 0.3125 lb a.i./A (1.5625 lb a.i./A total). These input parameters were modeled for all six standard groundwater scenarios. EDWCs for parent-only pymetrozine in groundwater source drinking water are shown in **Appendix C.1.** and summarized in **Table 11.** There was no breakthrough of parent-only pymetrozine into groundwater during a 30-year simulation, or 100-year simulation. However, there was a peak concentration of 0.09 µg/L, as an artifact of the dispersion of the pesticide through the soil profile. Therefore, pymetrozine by itself is not expected to significantly impact groundwater sourced for drinking water, but may reach shallow and vulnerable aquifers.

EDWCs for pymetrozine-TTR in groundwater source drinking water are shown in **Appendix C.2**, and summarized in **Table 12** at maximum label rates to outdoor Christmas, ornamentals, & fruits (nonbearing fruit and nut trees in nurseries) with five applications at an application of 0.3125 lb a.i./A (1.5625 lb a.i./A total). Contrary to parent-only analysis, there was breakthrough of pymetrozine-TTR into groundwater during a 30-year simulation. EDWCs in groundwater are not expected to exceed 367 µg/L as the post-breakthrough average, and 404 µg/L for the peak groundwater concentration.

The typical use rate for potatoes was also considered. Potatoes receive the highest quantity of pymetrozine on a national basis, at a typical (and maximum) label use rate of 0.172 lbs a.i./acre (0.193 kg/ha) with 2 applications. EDWCs for pymetrozine-TTR in groundwater source drinking water at typical rates are shown in **Appendix C.2.**, and summarized in **Table 13.** EDWCs in groundwater at typical use rates are not expected to exceed 79 µg/L as the post-breakthrough average, and 89 µg/L for the peak groundwater concentration.

Table 11. Groundwater Estimated Drinking Water Concentrations (Pymetrozine) at the Maximum Label Rate

GW Run ID	Peak (µg/L)	Post-Breakthrough Average (µg/L)
Delmarva	0	No Breakthrough
FL potato	0	No Breakthrough
FL Citrus	0.09	No Breakthrough
GA peanuts	0	No Breakthrough
NC Cotton	0	No Breakthrough
WI corn	0	No Breakthrough

Table 12. Groundwater Estimated Drinking Water Concentrations (TTR) at the Maximum Label Rate

GW Run ID	Peak (µg/L)	Post-Breakthrough Average (µg/L)
Delmarva	301	279
FL potato	61	59
FL Citrus	329	293
GA peanuts	117	104
NC Cotton	404	355
WI corn	399	367

Table 13. Groundwater Estimated Drinking Water Concentrations (TTR) at the Typical Potato Rate

GW Run ID	Peak (µg/L)	Post-Breakthrough Average (µg/L)
Delmarva	64	59
FL potato	13	13
FL Citrus	72	64
GA peanuts	26	23
NC Cotton	89	78
WI corn	87	79

Additional Groundwater Simulations

Additional groundwater modeling simulations were completed for pymetrozine-TTR that assessed alternate environmental fate model input parameters, as well as use assumptions, to determine the impact on exposure estimates. Typical use information compiled by BEAD was considered. Pymetrozine has the highest reported use on potatoes, which was included in the above analysis; however other typical use rates for other agricultural crops were also modeled for comparison, and are compiled in **Appendix**

D. Another approach involved modeling the lowest maximum labeled use rate (tomatoes with a single maximum rate of 0.043 lb a.i./A for 4 applications) and is also presented in **Appendix D**.

Other approaches with varying assumptions included; different mobility assumptions, sub-surface transformation, and surface transformation (i.e., aerobic soil metabolism) considering different radiolabeled studies (pyridine- and triazine- labeled), instead of only triazine-ring studies. All of these iterations and varying assumptions did not substantially change the EDWCs.

The six groundwater scenarios modeled in this DWA are based on known vulnerable groundwater supplies and were developed considering many factors, including weather, soil, and pesticide use. All six scenarios are located east of the Mississippi River; and as such, may not represent all vulnerable groundwater supplies across the country. To explore pymetrozine susceptibility to vulnerable groundwater on a national scale, reported national pymetrozine usage data on potatoes (Cropland Data Layers [CDL] from 2014, 2015, and 2016) were superimposed on the national nitrate leachate map, (Nolan, et al., 1997) along with the six groundwater scenario locations for reference. (**Figure 4).** The national nitrate leachate map illustrates locations in which nitrate has been quantified in groundwater, and is used here as a surrogate for vulnerable groundwater supplies.

The mapped data show the highest amount of pymetrozine use on potatoes is in Wyoming, Idaho Wisconsin, Maine, and Florida. Two of these locations (Wisconsin and Florida) are represented by the modeling scenarios (**Figure 4a**). This map illustrates potato production in the years 2014 thru 2016 (shades of orange) overlaid with areas of vulnerable groundwater (shades of blue, darker being more vulnerable). The gray circle represents the general area where the Wisconsin groundwater scenario was developed to represent. The other 3 locations of anticipated use are not proximal to sites represented by the standard scenarios, but in general, do align with areas of vulnerable groundwater (**Figure 4b**). This is expected since potatoes require well drained soil and high water inputs. Thus, supporting the expectation that pymetrozine use on potatoes may result in pymetrozine-TTR in shallow groundwater utilized as sourced drinking water.

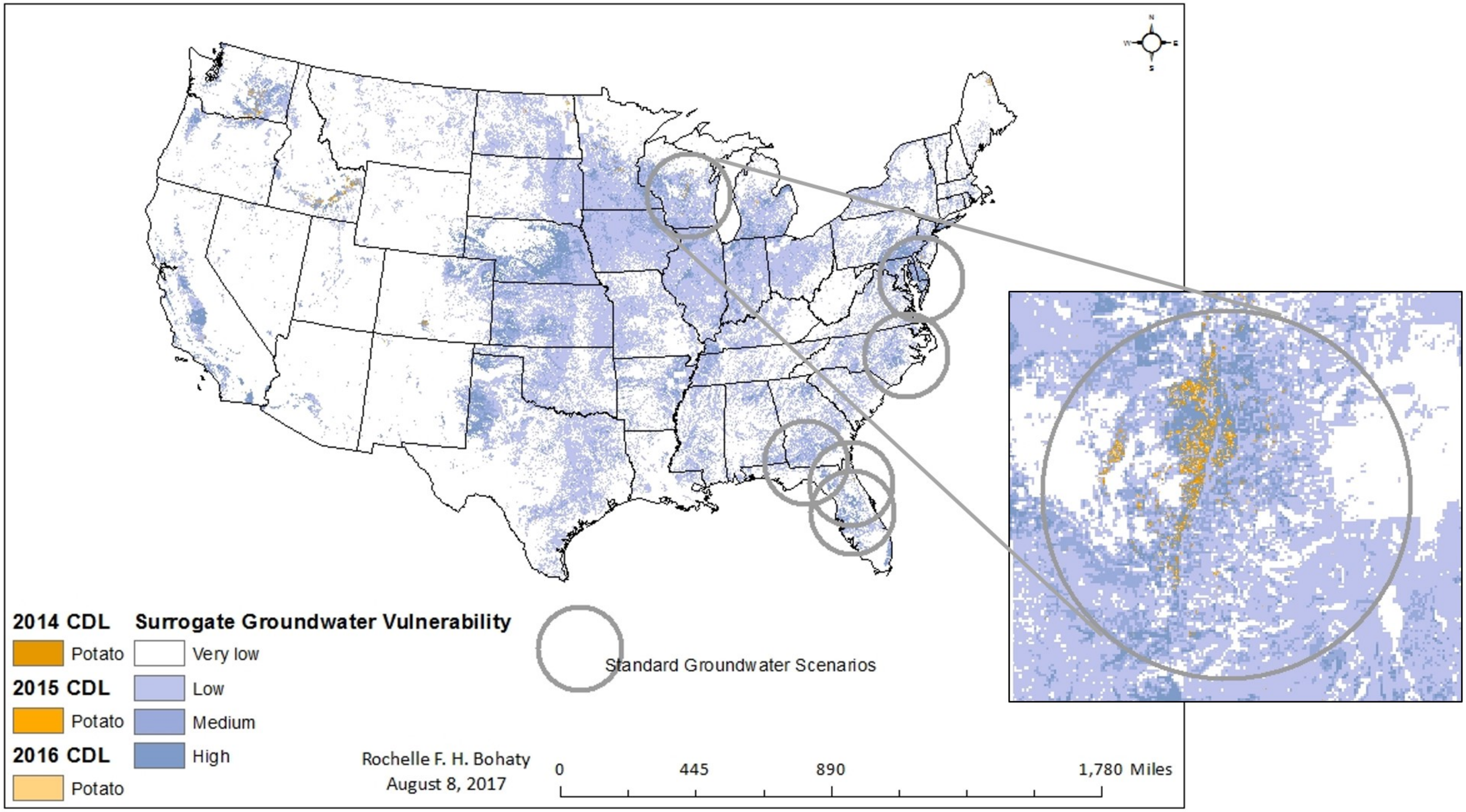

Figure 4a. Pymetrozine Potato Production and Groundwater Vulnerability Alignment with the Wisconsin Groundwater Scenario

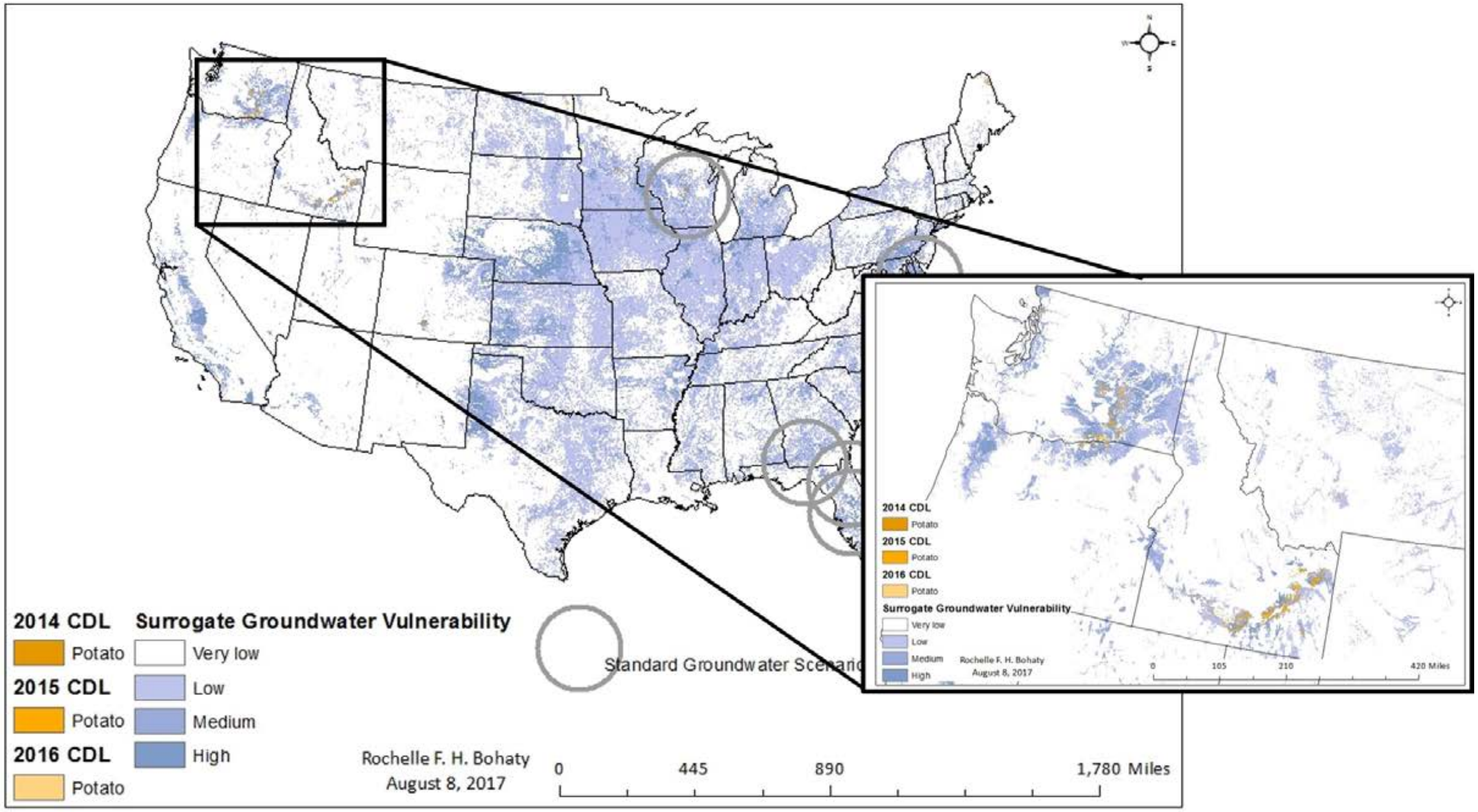

Figure 4b. Potato Growing Regions and Groundwater Vulnerability in the Pacific Northwest

Monitoring Data

Monitoring data were evaluated to assess pymetrozine concentrations in ambient surface water and groundwater. It does not appear as though any pymetrozine transformation products are currently being monitored in surface or groundwater across the country (**Table 14**). Pymetrozine was detected in 16 (22% detection frequency) out of a total of 74 samples from the California Department of Pesticide Regulation (CDPR), Surface Water (SURF) Database. The maximum concentration of pymetrozine in surface water was 0.25 µg/L.

Pymetrozine was also detected in one surface water sample and one groundwater sample out of over 3,000 samples analyzed for pymetrozine from the STORage and RETrieval (STORET) database. Pymetrozine was detected at a maximum concentration of 0.0032 µg/L in surface water collected from Oregon, and 0.0165 µg/L in groundwater collected from South Carolina.

According to national pymetrozine usage provided by the USGS, major use states include California, Washington, Georgia, Florida, and within the grouping of Wyoming, Colorado, Nebraska, and Kansas (Refer to **Figure 1**). Pymetrozine was sampled for in all of these locations, but was only detected in California.

Due to limited monitoring data, and no data on residues of concern, monitoring data was not used quantitatively in this risk assessment. However, for comparison, the monitoring data did not exceed the surface water modeling concentrations: 30-year annual average EDWC of 3 µg/L, daily average of 23 µg/L, and an annual average of 5 µg/L. Breakthrough of pymetrozine into groundwater is not likely, but possible based on physiochemical properties and modeling output. Breakthrough could occur in areas with karst soils or where macro particle transport through the soil occurs, or in cases of a shallow water table. The peak EDWC in groundwater for comparison is 0.09 µg/L.

Table 14. Monitoring Data Summary for Pymetrozine in Groundwater and Surface Water

Monitoring Program	Water Type	Number of Samples	Sites	Detection Frequency (%)	LOQ (µg/L)	Maximum Concentration (µg/L)	DWA EDWC for Comparison (µg/L)	
SURF[a]	Surface Water	74	10	22	0.002	**0.25**	**3**	(30-year annual average)
Storage and Retrieval (STORET)[b]	Surface Water	3170	1	0.03	0.002	**0.0032**	**3**	(30-year annual average)
	Groundwater	3170	1	0.03	0.002	**0.0165**	**0.09**	(Peak)

a. Data downloaded on June 10, 2017
b. Data downloaded from the Water Quality Portal on June 27, 2017
LOQ: Limit of Quantitation

Summary of Findings

Parent-pymetrozine and six transformation products (CGA 359009, CGA 363431, CGA 363430, CGA 215525, Hydroxy CGA 215525, and CGA 294849) were combined as TTR in this DWA. Based on maximum label use rates, pymetrozine TTR EDWCs from sourced surface water are not expected to exceed 47 µg/L as the daily average surface water concentration, 13 µg/L for the 1 in 10 year-annual average, and 10 µg/L for the 30-year annual average in the dietary risk assessment. EDWCs resulting from groundwater from vulnerable wells are not expected to exceed 367 µg/L as the post-breakthrough average, and 404 µg/L as the peak groundwater concentration.

Although pymetrozine was detected in low concentrations in surface water and groundwater monitoring data, these concentrations represent a minimal dataset and are determined not acceptable to quantify upper bound exposure for use in the dietary risk assessment.

Citations

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U.S. EPA, 2009. Guidance for Selecting Input Parameters in Modeling the Environmental Fate and Transport of Pesticides. Version 2.1 October 22, 2009. U.S. Environmental Protection Agency, Office of Pesticide Programs, Environmental Fate and Effects Division. Arlington, VA. < http://www.epa.gov/oppefed1/models/water/input_guidance2_28_02.html>

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USGS, 2017. U.S. Department of the Interior, U.S. Geological Survey. Pesticide National Synthesis Project. As assessed June 19, 2017. <https://water.usgs.gov/nawqa/pnsp/usage/maps/show_map.php?year=2014&map=PYMETROZINE&hilo=L&disp=Pymetrozine>

APPENDIX A
Pymetrozine Surface Water Scenario Development

ALFALFA (SLNS for ID, MT, OR, UT, WA)

Application Number	Application Timing; Type; Formulation	Date[b]	Minimum Retreatment Interval (days)	Method	Application Rate (lb a.i./A)	Scenario	Comments
1-2[a]	Foliar; Spray; Liquid	3/1	7	Aerial/ Ground	0.0859	CAalfalfa_WirrigOP	Perennial crop with stands living 3-5 years having multiple cuttings per year; however, alfalfa can be grown as part of a crop rotation that may results in more than 2 pymetrozine applications per year. Alfalfa is cut about every 30 days
		6/1				MNalfalfaOP NDwheatSTD	
Total					0.1719		

a. Not specified on the label (or specified in terms of crop cycle); however, one crop cycle is assumed to be equal to one year
b. When only one application date is noted, it indicates that subsequent application will occur at the minimum retreatment interval
Reg #s ID000010, MT030008, OR040005, UT000010, WA000016

ASPARAGUS

Application Number	Application Timing; Type[a]	Date[a]	Minimum Retreatment Interval (days)	Method	Application Rate (lb a.i./A)	Scenario	Comments
1-6	Foliar; Spray; Liquid	7/15[b]	30	Aerial/ Ground	0.0859	MIAsparagusSTD	EPA Reg. No. 100-912 indicates a PHI of 170 days. Seeds are planted in nurseries on year one. One crop per year, harvested every 1 to 3 days over a 3 to 4-week period. Once established, asparagus field remains in production for 8-10 years.
Total					0.5156		

a. When only one application date is noted, it indicates that subsequent application will occur at the minimum retreatment interval

b. Date based on meeting with BEAD on 5/31/17 Reg #: 100-912

OUTDOOR – CHRISTMAS, ORNAMENTALS, & FRUITS (Nonbearing fruit and nut trees in nurseries)

Application Number	Application Timing; Type	Date[a]	Minimum Retreatment Interval (days)	Method	Application Rate (lb a.i./A)	Scenario	Comments
1-5[b]	Foliar; Spray; Liquid	4/1	7	Ground spray/ Containerized plant	0.3125	ORXmasTreeSTD ORnurserySTD_V2 PAappleSTD_V2 NCappleSTD	Christmas Tree: For CA, do not exceed 1.5 lb a.i /A/year for indoor uses Ornamentals: For CA, do not apply 3.125 lb a.i/A/year for indoor and greenhouse non-food Fruits: For CA, do not apply 3.125 lb a.i/A/year for greenhouse non-food
		3/1[c]				TNnurserySTD_V2 CAnurserySTD_V2 FLnurserySTD_V2 MInurserySTD_V2 NJnurserySTD_V2	
Total					1.5625		
a. When only one application date is noted, it indicates that subsequent application will occur at the minimum retreatment interval b. Maximum of 5 applications per year assuming the maximum single application rate divided by the maximum yearly application rate c. Application based on meeting with BEAD on 5/31/2017 Reg #s: 100-913, 100-1574, 100-1585							

COLE CROPS AND VEGETABLES GROWN FOR SEED-SLN label (WA)

Application Number	Application Timing; Type	Date[a]	Minimum Retreatment Interval (days)	Method	Application Rate (lb a.i./A)	Scenario	Comments
1-6	Foliar; Broadcast; Liquid	3/15[b]	7	Aerial/ Ground	0.0859	CAColeCropRLF_V2 STXvegetableNMC	Cole Crops have a maximum application rate per year of 0.5156, with a maximum number of 6 applications per year assuming the maximum number of applications per crop cycle multiplied by the number of crop cycles possible per year. Vegetables frown for seed have a maximum application rate per year of

							0.5156, with a maximum number of 6 applications per year assuming the maximum number of applications per crop cycle multiplied by the number of crop cycles possible per year.
Total					0.5157		
a. When only one application date is noted, it indicates that subsequent application will occur at the minimum retreatment interval b. Application date selected based on meeting with BEAD on 5/31/2017 Reg #s 100-912, WA000017							

LEAFY VEGETABLES

Application Number[b]	Application Timing; Type	Date[a]	Minimum Retreatment Interval (days)	Method	Application Rate (lb a.i./A)	Scenario	Comments
1-4	Foliar; Broadcast; Liquid	2/1[b]	7	Aerial/ Ground	0.0859	CAlettuceSTD FLcabbageSTD	Leafy vegetables can have up to 2 crop cycles per year in rotation with other crops is possible in some locations; therefore, more than 4 applications of pymetrozine are possible.
Total					0.3438		
a. When only one application date is noted, it indicates that subsequent application will occur at the minimum retreatment interval b. Application date selected based on CA lettuce scenario Reg #s 100-912, WA000017							

VEGETABLES – ONE GROWING SEASON (CUCURBIT VEGETABLES & FRUITING VEGETABLES)

Application Number	Application Timing; Type	Date[a]	Minimum Retreatment Interval (days)	Method	Application Rate (lb a.i./A)	Scenario	Comments
1-2	Foliar; Broadcast; Liquid	11/1	7	Aerial/ Ground	0.0859	FLcucumberSTD FLpeppersSTD CAtomato_WirrigSTD	Cucurbits can be grown as part of a crop rotation that may results in more than 2 pymetrozine applications per year. Fruiting vegetables such as peppers, tomatoes, etc. can be grown as part of a crop rotation that may results in more than 2 pymetrozine applications per year.
		2/1				STXvegetableNMC STXmelonNMC	
		5/1				PAtomatoSTD.scn	

Total		0.1718	
a. When only one application date is noted, it indicates that subsequent application will occur at the minimum retreatment interval Reg #s 100-912, WA000017			

VEGETABLES – TWO GROWING SEASONS (CUCURBIT VEGETABLES & FRUITING VEGETABLES)

Application Number	Application Timing; Type	Date[a]	Minimum Retreatment Interval (days)	Method	Application Rate (lb a.i./A)	Scenario	Comments
1-2	Foliar; Broadcast; Liquid	2/1	7	Aerial/ Ground	0.0859	FLcucumberSTD STXmelonNMC FLpeppersSTD STXvegetableNMC CAtomato_WirrigSTD	See comments and footnotes in One Season table.
3-4		9/1			0.0859		
Total					0.3436		
a. Dates selected from meeting with BEAD on 5/31/2017							

VEGETABLES – THREE GROWING SEASONS (CUCURBIT VEGETABLES & FRUITING VEGETABLES)

Application Number	Application Timing; Type	Date	Minimum Retreatment Interval (days)	Method	Application Rate (lb a.i./A)	Scenario	Comments
1-2	Foliar; Broadcast; Liquid	1/1	7	Aerial/ Ground	0.0859	FLcucumberSTD FLpeppersSTD CAtomato_WirrigSTD	See comments and footnotes in One Season table.
3-4		5/1			0.0859		
5-6		9/1			0.0859		
Total					0.5154		

COTTON

Application Number	Application Timing; Type	Date[a]	Minimum Retreatment Interval (days	Method	Application Rate (lb a.i./A)	Scenario	Comments
1-2	Foliar; Broadcast; Liquid	6/1[b]	7	Aerial/ Ground	0.0859	NCCotton_PWC NCcottonSTD MScottonSTD CAcotton_WirrigSTD TXcottonOP STXcottonNMC	
Total					0.1719		
a. When only one application date is noted, it indicates that subsequent application will occur at the minimum retreatment interval b. Application date selected based on emergence date of NCCotton_STD of 5/15 Reg # 100-912							

HOPS

Application Number	Application Timing; Type	Date[a]	Minimum Retreatment Interval (days)	Method	Application Rate (lb a.i./A)	Scenario	Comments
1-3	Foliar; Spray; Liquid	4/15[b]	14	Ground	0.1875	ORhopsSTD	
Total					0.5625		
a. When only one application date is noted, it indicates that subsequent application will occur at the minimum retreatment interval b. Application date selected based on emergence date of 4/1 Reg # 100-912							

PECAN

Application Number	Application Timing; Type	Date[a]	Minimum Retreatment Interval (days)	Method	Application Rate (lb a.i./A)	Scenario	Comments
1-2	Foliar; Spray; Liquid	5/1[b]	7	Aerial/ Ground	0.125	GAPecansSTD.scn	
Total					0.25		
a. When only one application date is noted, it indicates that subsequent application will occur at the minimum retreatment interval							

b. Application date selected based on emergence date of 4/16 Reg # 100-912

POTATO, WHITE/IRISH, & ROOT TUBER VEGETABLES (Includes Oregon SLN)

Application Number	Application Timing; Type	Date[a]	Minimum Retreatment Interval (days	Method	Application Rate (lb a.i./A)	Scenario	Comments
1-2	Foliar; Spray; Liquid	6/1[b]	7	Aerial/ Ground/ Chemigation[c]	0.1719	FL potato_ForQA NCSweetPotatoSTD MEpotatoSTD IDNpotato_WirrigSTD CAPotatoRLF_V2 WApotatoNMC FLpotatoNMC FLcarrotSTD CAsugarbeet_WirrigOP MNsugarbeetSTD	Potato: Chemigation applications are prohibited in CA. Potatoes can be grown as part of a crop rotation that may results in more than 2 pymetrozine applications per year. Root and tuber vegetables can be grown as part of a crop rotation that may results in more than 2 pymetrozine applications per year. For OR only, only apply at an application rate of 0.0859 A.I. Max App rate, and 0.171875 lb/a/CC
Total					0.3438		

a. When only one application date is noted, it indicates that subsequent application will occur at the minimum retreatment interval
b. Application date selected based on IDNpotato_WirrigSTD of 6/1
c. Chemigation method only for potato, except in CA
Reg# 100-912, OR040004

TOBACCO

Application Number	Application Timing; Type	Date[a]	Minimum Retreatment Interval (days)	Method	Application Rate (lb a.i./A)	Scenario	Comments
1-2	Foliar; Spray; Liquid	5/15[b]	7	Ground	0.0859	NCtobaccoSTD.scn	Tobacco can be grown as part of a crop rotation that may results in

							more than 2 pymetrozine applications per year.
Total					0.1719		
a. When only one application date is noted, it indicates that subsequent application will occur at the minimum retreatment interval b. Application date selected based on meeting with BEAD on 5/31/2017 Reg # 100-912							

TOMATO - SLN (FL) (for enhanced management of whiteflies)

Application Number	Application Timing; Type	Date	Minimum Retreatment Interval (days)	Method	Application Rate (lb a.i./A)	Scenario	Comments
1-2	Foliar; Spray; Liquid	2/15	14	Aerial/Ground	0.043	FLtomatoSTD	Tomato can be grown as part of a crop rotation that may results in more than 4 pymetrozine applications per year.
2-4		4/1					
Total					0.172		
Reg # FL040006							

TOMATO SLN (FL) for tomatoes grown for transplant –TWO APPLICATIONS IN FIELD

Application Number[a]	Application Timing; Type	Date	Minimum Retreatment Interval (days)	Method	Application Rate (lb a.i./A)	Scenario	Comments
1-2	Foliar; Spray; Liquid	4/15	7	Aerial/ Ground	0.0859	FLtomatoSTD	There can be up to two applications pre-transplant in nursery at 0.0015 lb/a.i./A, which is assumed negligible and will not be modeled.
		4/22			0.0859		
Total					0.1718		

APPENDIX B.1

Surface Water Estimated Drinking Water Concentrations of Parent-Only Pymetrozine (PCA factor of 1)

Crops	Batch Run ID	App Rate (lb ai/A)	App #	1-in-10 year			Overall
				Peak	1-day	Year	
				µg/L			
Alfalfa	CAalfalfa_WirrigOP_a	0.0859	2	0.897	0.869	0.21	0.178
	CAalfalfa_WirrigOP_g			0.521	0.505	0.156	0.123
	MNalfalfaOP_a			0.949	0.923	0.273	0.236
	MNalfalfaOP_g			0.66	0.642	0.189	0.153
	NDwheatSTD_a			1.58	1.54	0.486	0.379
	NDwheatSTD_g			1.38	1.34	0.418	0.31
Asparagus	MIAsparagusSTD_a	0.0859	6	1.98	1.93	0.9	0.756
	MIAsparagusSTD_g			1.62	1.58	0.605	0.464
Outdoor – Christmas, Ornamentals, and Fruits (nonbearing fruit and nut trees in nurseries)	ORXmasTreeSTD_g	**0.3125**	**5**	3.3	3.24	1.45	1.24
	ORnurserySTD_V2_g			3.8	3.71	1.79	1.59
	PAappleSTD_V2_g			14.1	13.7	3.47	2.67
	NCappleSTD_g			23.4	22.7	4.38	3.04
	TNnurserySTD_V2_g			17.9	17.3	4.53	2.56
	FLnurserySTD_V2_g			**23.6**	**22.6**	**3.63**	**2.32**
	CAnurserySTD_V2_g			7.8	7.59	2.17	1.34
	MInurserySTD_V2_g			6.33	6.19	2.84	2.43
	NJnurserySTD_V2_g			15.3	14.8	3.95	3.13
Cole Crops and Vegetables Grown for Seed	CAColeCropRLF_V2_a	0.0859	6	4.46	4.36	1.53	1.01
	CAColeCropRLF_V2_g			3.92	3.83	1.37	0.838
	STXvegetableNMC_a			10.7	10.3	2.17	1.42
	STXvegetableNMC_g			10.9	10.5	2.13	1.35
Leafy Vegetables	CAlettuceSTD_a	0.0859	4	6.07	5.89	1.47	1.05
	CAlettuceSTD_g			5.75	5.58	1.37	0.935
	FLcabbageSTD_a			5.64	5.43	1.1	0.809
	FLcabbageSTD_g			5.81	5.59	1.06	0.758
Cotton	NCcottonSTD_a	0.0859	2	4.09	3.98	0.873	0.683
	NCcottonSTD_g			4.13	4.01	0.862	0.663
	MScottonSTD_a			3.92	3.78	0.72	0.485
	MScottonSTD_g			3.7	3.57	0.712	0.467
	CAcotton_WirrigSTD_a			1.01	0.981	0.275	0.233
	CAcotton_WirrigSTD_g			0.625	0.605	0.231	0.189
	TXcottonOP_a			5.09	4.91	0.758	0.533
	TXcottonOP_g			5.1	4.93	0.744	0.51

Crops	Batch Run ID	App Rate (lb ai/A)	App #	1-in-10 year Peak	1-in-10 year 1-day	1-in-10 year Year	Overall
				μg/L			
	STXcottonNMC_a			5.61	5.42	0.81	0.524
	STXcottonNMC_g			5.53	5.34	0.801	0.504
Hops	ORhopsSTD_g	0.1875	3	2.03	1.98	0.875	0.725
Pecan	GAPecansSTD_a	0.125	2	3.71	3.57	0.679	0.452
	GAPecansSTD_g			3.76	3.62	0.649	0.413
Potato, White/Irish, & Root Tuber Vegetables	FLpotatoNMC_a	0.1719	2	5.66	5.46	1.1	0.835
	FLpotatoNMC_g			5.57	5.36	1.08	0.798
	NCSweetPotatoSTD_a			8.85	8.58	1.73	1.2
	NCSweetPotatoSTD_g			8.78	8.51	1.69	1.15
	MEpotatoSTD_a			4.92	4.82	1.87	1.46
	MEpotatoSTD_g			4.75	4.65	1.78	1.36
	IDNpotato_WirrigSTD_a			1.94	1.89	0.699	0.66
	IDNpotato_WirrigSTD_g			1.17	1.14	0.553	0.516
	CAPotatoRLF_V2_a			1.97	1.91	0.323	0.291
	CAPotatoRLF_V2_g			1.18	1.15	0.214	0.185
	WApotatoNMC_a			2.27	2.21	0.839	0.618
	WApotatoNMC_g			2.23	2.17	0.683	0.464
	FLpotatoNMC_a			5.66	5.46	1.1	0.835
	FLpotatoNMC_g			5.57	5.36	1.08	0.798
	FLcarrotSTD_a			7.7	7.39	1.25	0.895
	FLcarrotSTD_g			7.67	7.35	1.23	0.87
	CAsugarbeet_WirrigOP_a			1.82	1.77	0.443	0.34
	CAsugarbeet_WirrigOP_g			1.01	0.981	0.335	0.231
	MNsugarbeetSTD_a			2.7	2.63	0.802	0.647
	MNsugarbeetSTD_g			2.27	2.21	0.657	0.498
Tobacco	NCtobaccoSTD	0.0859	2	2.28	2.21	0.354	0.24
Tomato SLN-tomatoes grown for transplant	FLtomatoSTD_V2_a	0.0859	2	1.78	1.72	0.333	0.233
	FLtomatoSTD_V2_g			1.83	1.76	0.331	0.226
Vegetables – One Growing Season (cucurbit vegetables and fruiting vegetables)	FLcucumberSTD_a	0.0859	2	2.82	2.71	0.509	0.363
	FLcucumberSTD_g			2.64	2.53	0.496	0.344
	CAtomato_WirrigSTD_a			1.26	1.22	0.398	0.285
	CAtomato_WirrigSTD_g			1.17	1.13	0.337	0.221
	FLpeppersSTD_a			2.85	2.74	0.523	0.37
	FLpeppersSTD_g			2.68	2.58	0.51	0.351
	STXvegetableNMC_a			2.96	2.86	0.641	0.445
	STXvegetableNMC_g			3.06	2.96	0.622	0.418
	STXmelonNMC_a			2.68	2.59	0.593	0.407

Crops	Batch Run ID	App Rate (lb ai/A)	App #	1-in-10 year Peak	1-in-10 year 1-day	1-in-10 year Year	Overall
				µg/L			
	STXmelonNMC_g			2.78	2.68	0.572	0.378
	PAtomatoSTD_a			2.33	2.26	0.64	0.485
	PAtomatoSTD_g			2.27	2.2	0.605	0.444
Vegetables – Two Growing Seasons (cucurbit vegetables and fruiting vegetables)	FLcucumberSTD	0.0859	4	5.27	5.07	1.14	0.83
	FLcucumberSTD			5.43	5.22	1.12	0.799
	CAtomato_WirrigSTD			2.86	2.78	0.675	0.466
	CAtomato_WirrigSTD			2.54	2.46	0.561	0.345
	STXvegetableNMC			8.38	8.08	1.42	0.964
	STXvegetableNMC			8.47	8.17	1.39	0.913
	FLpeppersSTD			5.18	4.98	1.03	0.78
	FLpeppersSTD			5.18	4.98	1.03	0.78
	STXmelonNMC			8.42	8.12	1.37	0.931
	STXmelonNMC			8.51	8.21	1.34	0.879
Vegetables – Three Growing Seasons (cucurbit vegetables and fruiting vegetables)	FLcucumberSTD	0.0859	6	6.32	6.07	1.7	1.27
	FLcucumberSTD			6.48	6.22	1.67	1.22
	CAtomato_WirrigSTD			3.43	3.34	1.01	0.705
	CAtomato_WirrigSTD			3.22	3.13	0.841	0.529
	FLpeppersSTD			6.16	5.93	1.63	1.21
	FLpeppersSTD			6.16	5.93	1.63	1.21
Tomato – SLN (FL)	FLtomatoSTD_V2	0.043	4	2.83	2.71	0.565	0.406
	FLtomatoSTD_V2			2.86	2.75	0.557	0.391
Bold indicates highest EDWCs							

APPENDIX B.2

Surface Water Estimated Drinking Water Concentrations of Pymetrozine-TTR (PCA factor of 1)

Crops	Batch Run ID	App Rate (lb ai/A)	App #	1-in-10 year Peak (µg/L)	1-in-10 year 1-day (µg/L)	1-in-10 year Year (µg/L)	Overall (µg/L)
Alfalfa	CAalfalfa_WirrigOP_a	0.0859	2	2.3	2.3	1.2	0.9
	CAalfalfa_WirrigOP_g			1.8	1.8	0.9	0.6
	MNalfalfaOP_a			5.4	5.4	3.7	2.7
	MNalfalfaOP_g			4.8	4.8	3.3	2.3
	NDwheatSTD_a			6.7	6.7	3.8	3.0
	NDwheatSTD_g			6.4	6.4	3.6	2.8
Asparagus	MIAsparagusSTD_a	0.0859	6	7.9	7.9	6.8	5.5
	MIAsparagusSTD_g			5.6	5.6	4.4	3.3
Outdoor – Christmas, Ornamentals, and Fruits (nonbearing fruit and nut trees in nurseries)	ORXmasTreeSTD_g	**0.3125**	**5**	11.7	11.7	8.0	6.0
	ORnurserySTD_V2_g			13.7	13.7	7.9	6.5
	PAappleSTD_V2_g			25.7	25.6	11.0	7.5
	NCappleSTD_g			31.9	31.7	11.3	6.8
	TNnurserySTD_V2_g			47.4	47.0	13.4	6.9
	FLnurserySTD_V2_g			**47.8**	**47.3**	**10.9**	**4.4**
	CAnurserySTD_V2_g			20.2	20.2	13.4	9.5
	MInurserySTD_V2_g			23.9	23.8	11.3	9.4
	NJnurserySTD_V2_g			42.1	41.8	13.3	8.6
Cole Crops and Vegetables Grown for Seed	CAColeCropRLF_V2_a	0.0859	6	24.4	24.3	11.6	7.4
	CAColeCropRLF_V2_g			24.0	23.9	11.3	6.9
	STXvegetableNMC_a			42.7	42.4	11.7	7.0
	STXvegetableNMC_g			43.5	43.2	11.8	6.9
Leafy Vegetables	CAlettuceSTD_a	0.0859	4	21.5	21.5	13.2	7.7
	CAlettuceSTD_g			21.3	21.3	13.1	7.4
	FLcabbageSTD_a			13.0	12.9	3.8	2.6
	FLcabbageSTD_g			13.0	12.9	3.8	2.4
Cotton	NCcottonSTD_a	0.0859	2	8.2	8.1	2.6	1.7
	NCcottonSTD_g			8.0	8.0	2.5	1.6
	MScottonSTD_a			8.1	8.0	1.5	0.7
	MScottonSTD_g			8.0	7.9	1.5	0.7
	CAcotton_WirrigSTD_a			2.0	2.0	1.0	0.9
	CAcotton_WirrigSTD_g			1.5	1.5	0.8	0.7
	TXcottonOP_a			8.4	8.4	2.5	1.7
	TXcottonOP_g			8.4	8.4	2.4	1.6
	STXcottonNMC_a			17.1	16.9	4.6	2.7

Crops	Batch Run ID	App Rate (lb ai/A)	App #	1-in-10 year			Overall
				Peak	1-day	Year	
				µg/L			
	STXcottonNMC_g			17.4	17.3	4.7	2.6
Hops	ORhopsSTD_g	0.1875	3	4.7	4.7	2.2	1.8
Pecan	GAPecansSTD_a	0.125	2	8.0	7.9	1.7	0.8
	GAPecansSTD_g			7.7	7.7	1.6	0.7
Potato, White/Irish, & Root Tuber Vegetables	FLpotatoNMC_a	0.1719	2	25.5	25.2	4.6	2.9
	FLpotatoNMC_g			25.8	25.5	4.7	2.9
	NCSweetPotatoSTD_a			16.3	16.2	4.9	2.6
	NCSweetPotatoSTD_g			15.9	15.8	4.8	2.4
	MEpotatoSTD_a			6.8	6.8	3.7	2.8
	MEpotatoSTD_g			6.4	6.3	3.4	2.5
	IDNpotato_WirrigSTD_a			4.0	3.9	2.2	1.9
	IDNpotato_WirrigSTD_g			2.7	2.7	1.5	1.1
	CAPotatoRLF_V2_a			4.7	4.6	2.9	2.6
	CAPotatoRLF_V2_g			3.0	3.0	1.9	1.6
	WApotatoNMC_a			9.3	9.3	6.0	4.4
	WApotatoNMC_g			7.9	7.9	4.7	3.1
	FLpotatoNMC_a			25.5	25.2	4.6	2.9
	FLpotatoNMC_g			25.8	25.5	4.7	2.9
	FLcarrotSTD_a			23.2	22.9	3.6	2.3
	FLcarrotSTD_g			23.4	23.1	3.6	2.3
	CAsugarbeet_WirrigOP_a			7.1	7.1	5.7	4.3
	CAsugarbeet_WirrigOP_g			6.4	6.4	5.0	3.6
	MNsugarbeetSTD_a			12.4	12.4	8.1	5.8
	MNsugarbeetSTD_g			11.6	11.6	7.6	5.2
Tobacco	NCtobaccoSTD	0.0859	2	2.0	1.9	0.8	0.6
Tomato SLN-tomatoes grown for transplant	FLtomatoSTD_V2_a	0.0859	2	6.3	6.2	0.9	0.5
	FLtomatoSTD_V2_g			6.3	6.3	0.9	0.5
Vegetables – One Growing Season (cucurbit vegetables and fruiting vegetables)	FLcucumberSTD_a	0.0859	2	11.8	11.6	1.6	0.9
	FLcucumberSTD_g			11.8	11.7	1.6	0.9
	CAtomato_WirrigSTD_a			6.2	6.2	3.6	2.9
	CAtomato_WirrigSTD_g			5.7	5.7	3.3	2.5
	FLpeppersSTD_a			11.9	11.8	1.7	1.0
	FLpeppersSTD_g			12.0	11.8	1.8	1.0
	STXvegetableNMC_a			10.7	10.7	3.5	2.2
	STXvegetableNMC_g			10.8	10.7	3.5	2.1
	STXmelonNMC_a			9.3	9.2	3.0	1.9
	STXmelonNMC_g			9.5	9.4	3.0	1.9

Crops	Batch Run ID	App Rate (lb ai/A)	App #	1-in-10 year			Overall
				Peak	1-day	Year	
				µg/L			
	PAtomatoSTD_a			3.8	3.8	1.6	1.1
	PAtomatoSTD_g			3.5	3.5	1.4	0.9
Vegetables – Two Growing Seasons (cucurbit vegetables and fruiting vegetables)	FLcucumberSTD	0.0859	4	13.7	13.5	2.9	2.1
	FLcucumberSTD			13.9	13.8	2.9	2.0
	CAtomato_WirrigSTD			11.4	11.4	7.3	5.1
	CAtomato_WirrigSTD			10.8	10.8	6.8	4.4
	STXvegetableNMC			17.7	17.6	6.8	4.7
	STXvegetableNMC			18.1	18.0	6.8	4.6
	FLpeppersSTD			10.5	10.4	2.5	1.7
	FLpeppersSTD			10.5	10.4	2.5	1.7
	STXmelonNMC			15.4	15.3	6.4	4.5
	STXmelonNMC			15.5	15.4	6.3	4.4
Vegetables – Three Growing Seasons (cucurbit vegetables and fruiting vegetables)	FLcucumberSTD	0.0859	6	15.7	15.5	3.9	3.1
	FLcucumberSTD			15.9	15.7	3.8	3.1
	CAtomato_WirrigSTD			16.0	15.9	10.8	7.5
	CAtomato_WirrigSTD			15.1	15.1	10.0	6.5
	FLpeppersSTD			15.3	15.1	3.7	2.9
	FLpeppersSTD			15.3	15.1	3.7	2.9
Tomato – SLN (FL)	FLtomatoSTD_V2	0.043	4	7.2	7.1	1.3	0.8
	FLtomatoSTD_V2			7.3	7.2	1.3	0.8
Bold indicates highest EDWCs							

Appendix C.1

Ground Water Estimated Drinking Water Concentrations of Parent-Only Pymetrozine

Crops	GW Run ID	App Rate (lbs ai/A)	App #	Peak (µg/L)	Breakthru (days)	PostBT Avg (µg/L)	Sim Avg (µg/L)
Outdoor – Christmas, Ornamentals, and Fruits (nonbearing fruit and nut trees in nurseries) *Highest Maximum Use Rate	Delmarva	0.3125	5	0.00	-999999.00	-999999.00	0.00
	FL potato			0.00	-999999.00	-999999.00	0.00
	FL Citrus			0.09	-999999.00	-999999.00	0.02
	GA peanuts			0.00	-999999.00	-999999.00	0.00
	NC Cotton			0.00	-999999.00	-999999.00	0.00
	WI corn			0.00	-999999.00	-999999.00	0.00

Appendix C.2

Ground Water Estimated Drinking Water Concentrations of Pymetrozine-TTR

Crops	GW Run ID	App Rate (lbs ai/A)	App #	Peak (µg/L)	Breakthru (days)	PostBT Avg (µg/L)	Sim Avg (µg/L)
Outdoor – Christmas, Ornamentals, and Fruits (nonbearing fruit and nut trees in nurseries) *Highest Maximum Use Rate	Delmarva	0.3125	5	301	4827	279	164
	FL potato			61	6313	59	36
	FL Citrus			329	3924	293	216
	GA peanuts			117	6062	104	55
	NC Cotton			404	4917	355	206
	WI corn			399	6471	367	180
Potato *Typical Use Rate	Delmarva	0.172	2	64	4827	59	35
	FL potato			13	6313	13	8
	FL Citrus			72	3924	64	47
	GA peanuts			26	6062	23	12
	NC Cotton			89	4917	78	45
	WI corn			87	6471	79	39

Appendix D

Summary Table of Estimated Drinking Water Concentration Iterations

Drinking Water Source	Use Site	Residue	Application Rate	Pesticide Root Zone Model – Variable Volume Water Model (PRZM-VVWM)		
				1-in-10 Year Concentration (µg/L)		30 Year Annual Average Concentration (µg/L)
				Daily Average	Annual Average	
Surface Water	Outdoor – Christmas trees, Ornamentals, & Fruits (Nonbearing fruit and nut trees in nurseries); Index Reservoir	Pymetrozine	Maximum Use Rate[a]	23	5	3
		TTR		47	13	10

Drinking Water Source	Use Site	Residue	Application Rate	Model Scenario	Pesticide Root Zone Model – Groundwater (PRZM-GW) Concentration (µg/L)	
					Peak	Post-Breakthrough Average
Groundwater	Outdoor – Christmas trees, Ornamentals, & Fruits (Nonbearing fruit and nut trees in nurseries); Unconfined well	Pymetrozine	Maximum Use Rate[a]	Delmarva	0.000006	NA
				FL potato	0.000000003	NA
				FL citrus	**0.09**	NA
				GA peanuts	0.0000000001	NA
				NC cotton	0.000201	NA
				WI corn	0.0000001	NA
		TTR		Delmarva	301	279
				FL potato	61	59
				FL citrus	329	293
				GA peanuts	117	104
				NC cotton	**404**	355
				WI corn	399	**367**
	Non-agriculture outdoor crops	TTR	Typical Use Rate[b]	Delmarva	51	47
				FL potato	10	10
				FL citrus	57	50
				GA peanuts	20	18
				NC cotton	**70**	62
				WI corn	68	**63**
	Potatoes	TTR	Typical Use Rate[c]	Delmarva	64	59
				FL potato	13	13
				FL citrus	72	64
				GA peanuts	26	23
				NC cotton	**89**	78
				WI corn	87	**79**
	Tomatoes-SLN (FL)	TTR	Lowest Maximum Use Rate[d]	Delmarva	33	31
				FL potato	7	6
				FL citrus	36	32
				GA peanuts	13	11
				NC cotton	**44**	39
				WI corn	**44**	**40**

	General Vegetables[e]	TTR	Typical Use Rate[f]	Delmarva	16	15
				FL potato	3	3
				FL citrus	18	16
				GA peanuts	6	6
				NC cotton	**22**	19
				WI corn	**22**	**20**

a) Total max single labeled rate: 0.3125 lb a.i./acre with 5 applications
b) Typical rate, BEAD: 0.136 lbs a.i./acre (0.152 kg/ha) with assumed 2 applications based on reported average
c) Typical rate, BEAD: 0.172 lbs a.i./acre (0.193 kg/ha) with 2 applications based on the 90th percentile
d) Lowest maximum labeled rate: 0.043 lb a.i/acre (0.048 kg/ha) with 4 applications
e) General Vegetables include: Asparagus, Broccoli, Cantaloupes, Cauliflower, Celery, Lettuce, Peppers, Pumpkins, and Spinach
f) Typical rate, BEAD: 0.086 lb a.i/acre (0.096 kg/ha) with 1 application

NA – not applicable, no breakthrough, **bold** indicates highest EDWCs for each use site